DINAMAP®

PRO Series 100 - 400 V2 Service Manual (Models 110 - 410)

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DINAMAP® PRO 100-400 V2
Patient Monitor
Service Manual

NOTE

The Model Numbers 100 through 400 are generic in nature and reflect the range of product codes available. Your product may be labeled with a specific product code such as DINAMAP® PRO Model 410. “V2” refers to the second version of the product’s design.

2009829-001 Revision A

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DINAMAP® PRO 100-400 Patient Monitor Service Manual

This manual is for DINAMAP PRO Monitors models 100, 200, 300, and 400, with or without printers.

- PRO 100: BP, Pulse
- PRO 200: BP, Pulse, and Temp
- PRO 300: BP, Pulse, and SpO_2
- PRO 400: BP, Pulse, Temp, and SpO_2

The model of the Monitor determines which parameters are in your monitor. Please refer to applicable sections.

Reissues and Updates

Changes occurring between issues are addressed through Change Information Sheets, Addendums, and replacement pages. If a Change Information Sheet does not accompany this manual, it is correct as printed.

Errors and Omissions

If errors or omissions are found in this manual, please notify:
GE Medical Systems *Information Technologies*
Technical Publications
4502 Woodland Corporate Boulevard
Tampa, FL 33614
1-877-274-8456

Part No. 2009829-001 A

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Illustrations may show design models; production units may incorporate changes.

Hierarchy of Warnings and Cautions

A **general warning** is a statement that alerts the user to the possibility of injury, death, or other serious adverse reactions associated with the misuse of the device. A **warning** relates to steps in a procedure.

A **general caution** is a statement that alerts the user to the possibility of a problem with the device associated with its use or misuse. Such problems include device malfunction, device failure, damage to the device or damage to other property. A **caution** relates to steps in a procedure.

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Table of Contents

Section 1 - Introduction

1.1 Introduction 1-5

1.2 Addenda 1-6

1.3 Trademarks and Trade Names 1-6

1.4 Service Policy 1-6

1.5 Extended Warranties 1-6

1.6 Assistance 1-6

1.7 Service 1-7

1.7.1 Packing Instructions 1-7

1.7.2 Insurance 1-7

1.7.3 Replacement Assemblies and Components 1-8

1.7.4 Replacement Assemblies 1-8

1.8 Installation and Operation 1-9

1.9 Warnings and Precautions 1-9

1.10 Symbol Definitions 1-10

1.11 Glossary of Terms and Abbreviations 1-11

Section 2- Product Description

2.1 Introduction 2-5

2.2 Product Configurations 2-5

2.3 Controls, Indicators, and Connectors 2-5

2.3.1 PRO Series Monitor Rear Panel Connections 2-6

2.3.2 Front Panel Controls and Indicators 2-7

2.4 Host Port Connector (rear panel) 2-9

2.5 Compatible Parts 2-10

2.6 Specifications 2-12

2.6.1 Power Requirements 2-12

2.6.2 Environmental 2-12

2.6.3 Mechanical 2-12

2.6.4 BP 2-13
2.6.5 Temperature 2-13
2.6.6 SpO2 2-14

Section 3- Theory of Operation

3.1 Introduction 3-5
3.2 Overall Theory Of Operation 3-5
3.2.1 Cuff Blood Pressure (BP) and Pulse 3-5
3.2.2 Temperature (Model 200 and 400) 3-6
3.2.3 SPO2 (Model 300 and 400) 3-6
3.2.4 Host Communication Port 3-6
3.3 Functional Description 3-7
3.3.1 PSU PWA 3-7
3.3.2 PSU Module 3-7
3.3.3 Main Board 3-7
3.3.4 SPO2 PWA (Optional) 3-8
3.3.5 Pneumatic Control Device 3-9
3.3.6 LCD Assembly 3-9
3.3.7 Printer PWA w/Printer 3-9

Section 4- Calibration & Maintenance

4.1 Introduction 4-5
4.2 Fuses 4-5
4.3 Periodic Maintenance 4-5
4.3.1 Cleaning the Monitor 4-5
4.3.2 Power Up Checks 4-6
4.3.3 External DC Supply and Battery 4-7
4.3.4 Care Of The Storage Battery 4-7
4.3.5 Checking NIBP Calibration 4-7
4.4 Clinician Mode 4-8

4.4.1 Accessing the Clinician Mode 4-8

4.4.2 Clinician Mode Main Menu 4-9

4.4.3 Clinician More...Menu 4-10

4.5 Service Mode 4-11

4.5.1 Accessing the Service Mode 4-11

4.5.2 Service Mode Main Menu 4-12

4.5.3 NIBP Menu 4-13

4.5.4 System Menu 4-14

4.6 Pre-Service Test Procedures 4-16

4.6.1 SpO_2 Checks (PRO 300 & 400) 4-16

4.6.2 Leak Test 4-17

4.6.3 NIBP Calibration Check 4-18

4.6.4 Neonate Overpressure Check 4-19

4.6.5 Adult Overpressure Check 4-20

4.6.6 Temperature System Check (PRO 200 and 400) 4-20

4.6.7 Printer Test 4-21

4.7 PRO Monitor Calibration Procedures 4-21

4.7.1 Calibrating the NIBP Transducer 4-21

4.7.2 Overpressure Adjustment 4-22

4.8 Electrical System Safety Checks 4-25

Section 5- Schematics & Drawings

5.1 Field Replaceable Parts 5-3

Drawing, Front Case with Temp (3 sheets) 5-7/8

Drawing, Rear Case (4 sheets) 5-13/14

Schematic, Main Board (9 sheets) 5-21/22

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1 Introduction

For your notes

Table of Contents

1.1. Introduction 1-5
1.2. Addenda 1-6
1.3. Trademarks and Trade Names 1-6
1.4. Service Policy 1-6
1.5. Extended Warranties 1-6
1.6. Assistance 1-6
1.7. Service 1-7
1.7.1. Packing Instructions 1-7
1.7.2 Insurance 1-7
1.7.3. Replacement Assemblies and Components 1-8
1.7.4 Replacement Assemblies 1-8
1.8. Installation and Operation 1-9
1.9. Warnings and Precautions 1-9
1.10. Symbol Definitions 1-10
1.11. Glossary of Terms and Abbreviations 1-11

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Section 1. INTRODUCTION

1.1. SCOPE OF MANUAL

This service manual provides service, parts, and repair information and functional descriptions for the DINAMAP® PRO Series Monitors, Models 100, 200, 300, and 400. The model number identifies the vital signs monitoring capabilities built into the unit.

- PRO 100: BP, pulse
- PRO 200: BP, pulse, temperature
- PRO 300: BP, pulse, SpO_2
- PRO 400: BP, pulse, temperature, SpO_2

This manual is intended for use by biomedical engineers and trained service technicians who are familiar with electromechanical devices and digital and analog circuit techniques.

WARNING

To reduce the risk of electric shock, do not open the case. No user-serviceable parts are inside the case. Refer servicing to qualified service personnel.

Trained service technicians should perform all unit repairs.

Voltages dangerous to life exist in this unit. Take care when servicing power supply and display assembly.

For information about operating PRO Series Monitors in a clinical environment, refer to the separate operation manual.

This service manual is composed of the following five sections:

- Section 1 describes this manual and tells you how to use it. Information is also provided about how to get assistance if the unit fails to function properly.
- Section 2 provides the physical and functional characteristics of the PRO Series Monitor.
- Section 3 explains the principles of operation for the PRO Series Monitor, including an overall system description and principles of operation at the PWA (printed wiring board) level.
- Section 4 provides information about periodic and corrective maintenance of the PRO Series Monitor. Procedures include calibration checks, recalibration, performance tests, and fault isolation.
- Section 5 provides component information about the PRO Series Monitor, including disassembly procedures, parts lists, assembly diagrams, and electrical schematics.

1.2. ADDENDA

When this manual was published it included the most up-to-date information and procedures available. However, the specifications, design, assembly, or software controls may change. These changes are incorporated into this manual by addenda.

1.3. TRADEMARKS AND TRADE NAMES

This document references terms that are proprietary, and may be registered and protected by copyrights and other applicable laws and agreements.

The first time trademarks and trade names are used in a section of this document, they are followed by “*” or “**”. A footnote will identify the owner of the trademark or trade name.

1.4. SERVICE POLICY

The warranty for this product is enclosed with the product in the shipper carton. All repairs on products under warranty must be performed or approved by Customer Support personnel. Unauthorized repairs will void the warranty. Products not covered by warranty should be repaired by qualified electronics service personnel.

1.5. EXTENDED WARRANTIES

Extended warranties may be purchased on most products. Contact your Sales Representative for details and pricing.

1.6. ASSISTANCE

If the product fails to function properly or if assistance, service, or spare parts are required, contact Customer Support. Before contacting Customer Support, it is helpful to attempt to duplicate the problem and to check all accessories to ensure that they are not the cause of the problem. If you are unable to resolve the problem after checking these items, contact Customer Support. When you call, please be prepared to provide:

- Product name and model number
- A complete description of the problem

If repair parts or service are necessary, you will also be asked to provide:

- The product serial number
- The facility's complete name and address

- A purchase order number if the product is to be sent for repairs or you order spare parts
- The facility's GE Medical Systems Information Technologies account number, if possible
- The part number for replacement assemblies or parts

1.7. SERVICE

If your product requires repair service, call Customer Support and a representative will assist you. Prior to returning any product for repair, you must request a Return Authorization number. Call GE Medical Systems Information Technologies at: 1-877-274-8456 Monday through Friday, 8:00 a.m. to 6:00 p.m. EST, excluding holidays.

1.7.1. Packing Instructions

Follow these recommended packing instructions.

- Remove the battery and all hoses, cables, sensors, and power cords from the PRO Series Monitor before packing.
- Pack only the accessories you are requested to return. Place them in a separate bag and insert the bag and the product inside the shipping carton.
- Use the original shipping carton and packing materials, if available.
- If the original shipping carton is not available, place the product in a plastic bag and tie or tape the bag to prevent loose particles or materials from entering openings such as the hose ports.
- Use a sturdy corrugated container to ship the product; tape securely to seal the container for shipping.
- Pack with 4 in. to 6 in. of padding on all sides of the product.

1.7.2. Insurance

Insurance is at the customer's discretion. Claims for damage to the product must be directed to the shipper.

1.7.3. Replacement Assemblies and Components

Assemblies and components can be ordered from GE Medical Systems Information Technologies:

Via phone: 1-800-558-7044, Option #2

Via FAX: 1-800-232-2599

Information is also available on the World Wide Web at:

http://www.gemedical.com

All orders must include the following information:

- Facility's complete name, address, and phone number
- FAX number
- Your purchase order number
- Your GE Medical Systems Information Technologies account number

Please allow one working day for confirmation of your order.

1.7.4. Replacement Accessories

Replacements such as hoses, sensors, etc. must be purchased from GE Medical Systems Information Technologies at 1-800-558-5102 (fax 1-800-232-2599). Please have the Reorder/Product Code or part number of the item you wish to order, and your purchase order and account number available.

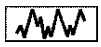
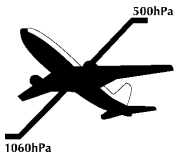
1.8. INSTALLATION AND OPERATION

For information on the installation and operation of the PRO Series Monitor, refer to the separate operation manual. The PRO Series Monitor should be operated and serviced by authorized personnel, and only in accordance with the warnings and precautions given in both the operation manual and this service manual.

1.9. WARNINGS AND PRECAUTIONS

Refer to the operating safety warnings and precautions detailed in the separate operation manual.

1.10. SYMBOL DEFINITIONS

	Attention: consult accompanying documents
	Power Off/On
	Silence Alarms
	START/STOP BP
	AUTO BP
	Mean Arterial Pressure
	External Communications Port Connector
	Defibrillator-proof Type B.F. equipment
	SpO2
	Temperature Value
	Battery Power
	External AC or DC power
	SpO2 Motion Artifact (US)
	SpO2 Motion Artifact (Europe)
	Packaging label depicting the transportation and storage atmospheric pressure range of 500 to 1060 hPa
IPX1	The DINAMAP® PRO Series Monitor is protected against vertically falling drops of water and conforms with the IEC 529 standard at level of IPX1. No harmful effects will come of vertically falling drops of water making contact with the Monitor

1.11. GLOSSARY OF TERMS AND ABBREVIATIONS

AC	Alternating Current
ADC	Analog to Digital Convertor
ADU	Analog to Digital Units: The Main Board has 65,536 steps which equates to 5V full scale (76 µV/ADU) Secondary Processor ADC has 256 steps which equates to 5V full scale (19.351 mV/ADU)
AM	Amplitude Modulation
ASSY	Assembly
BP	Blood Pressure
BPM	Beats Per Minute
DC	Direct Current
DMM	Digital Multimeter
FET	Field Effect Transistor
GAL	Gate Array logic
mb	Millibar
mmHg	Millimeters of Mercury
HCD	Host Communications Device
Hz	Hertz
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MAP	Mean Arterial Pressure
NIBP	Non Invasive Blood Pressure
NiMh	Nickel Metal Hydride
OSC	Oscillatory
PSU	Power Supply Unit
PWA	Printed Wiring Assembly
SPI	Serial Peripheral Interface
TTL	Transistor to Transistor Logic
UUT	Unit Under Test
VAC	Volts Alternating Current
VDC	Volts Direct Current
VFC	Voltage to Frequency Convertor

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2 Product Description

For your notes

Table of Contents

2.1. Introduction 2-5
2.2. Product Configurations 2-5
2.3. Controls, Indicators, and Connectors 2-5
2.3.1. PRO Series Monitor Rear Panel Connections 2-6
2.3.2. Front Panel Controls and Indicators 2-7
2.4. Host Port Connector (rear panel) 2-9
2.5. Compatible Parts 2-10
2.6. Specifications 2-12
2.6.1. Power Requirements 2-12
2.6.2. Environmental 2-12
2.6.3. Mechanical 2-12
2.6.4. BP 2-13
2.6.5. Temperature 2-13
2.6.6. SpO2 2-14

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SECTION 2. PRODUCT DESCRIPTION

2.1. INTRODUCTION

DINAMAP® PRO Series 100-400 Monitors provide non-invasive determination of systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse rate, temperature, and oxygen saturation. These portable AC and DC operated monitors are primarily intended for use in hospital acute care settings such as outpatient surgery, accident and emergency, labor and delivery, GI/ endoscopy, and medical/surgical units.

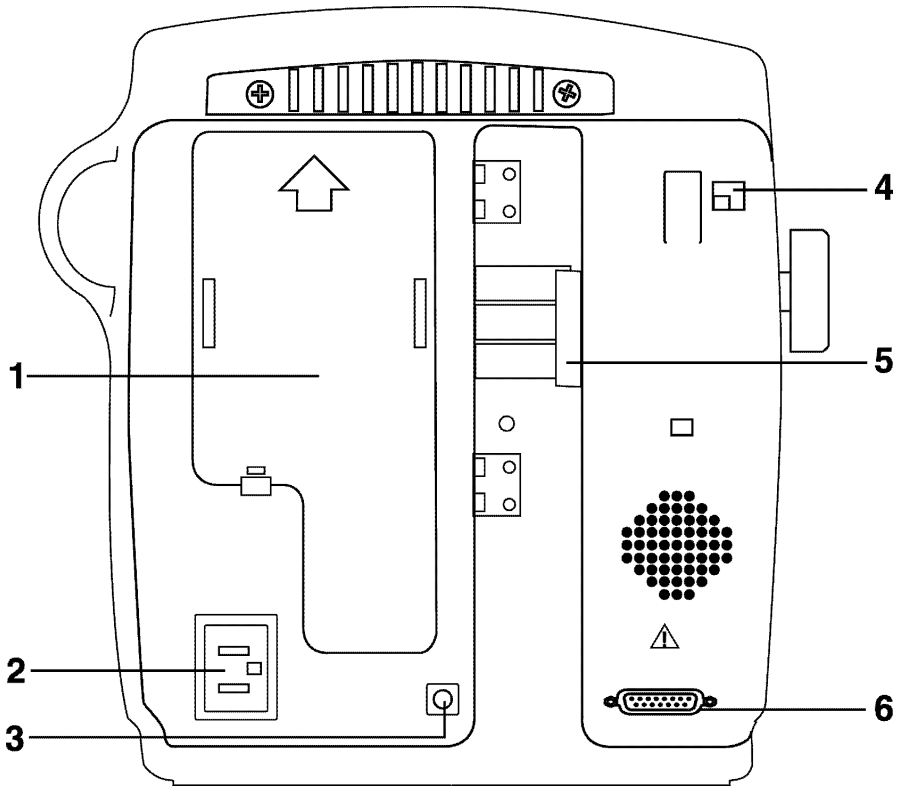
2.2. PRODUCT CONFIGURATIONS

Each PRO Series Monitor is supplied with an accessory pack. The contents of the pack vary according to model. Unpack the items carefully, and check them against the contents checklist enclosed in one of the accessory boxes. If there is a problem or shortage, contact GE Medical Systems Information Technologies.

It is recommended that all the packaging be retained, in case the PRO Series Monitor must be returned for service in the future.

2.3. CONTROLS, INDICATORS, AND CONNECTORS

Descriptions of the items shown are listed on the pages that follow. For symbol definitions, refer to Section 1 of this manual.



2.3.1. PRO Series Monitor Rear Panel Connections

1. Battery compartment cover: Retains and protects the internal battery.

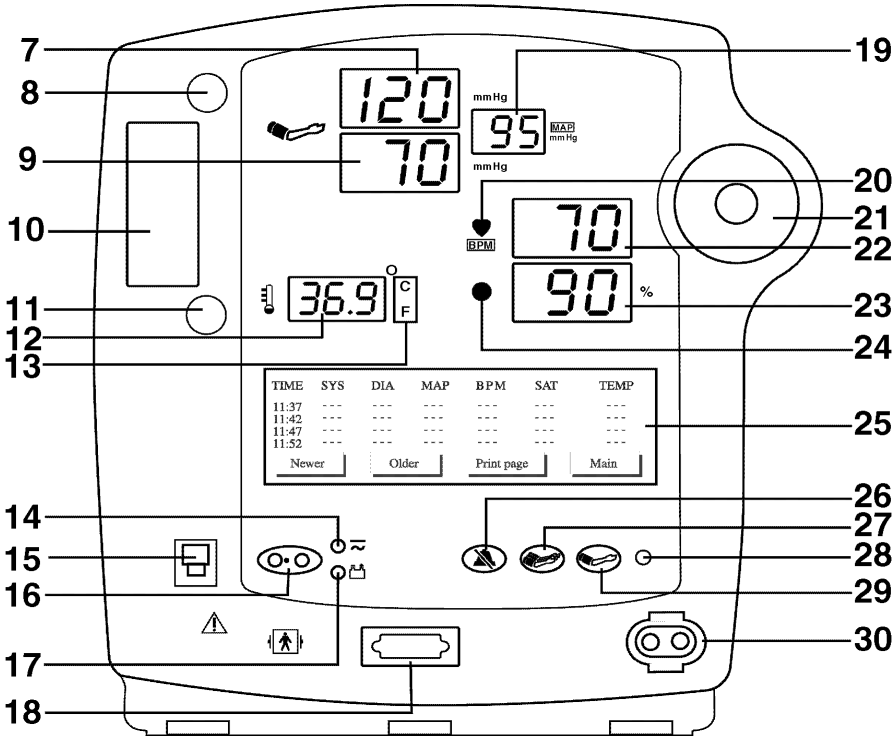
2. Mains input: Used to connect to AC power supply.

3. External power socket: To be used with approved AC-DC power converter ONLY.

4. Inactive temperature cable storage: Inactive temperature probe cable attaches here (Models 200 and 400).

5. Pole clamp: Used to clamp monitor to pole or stand.

6. Data interface connector: Host communications port (15 way D-type RS-232 serial port) for use only with equipment conforming to IEC 601-1. Refer to section 2.4 for connection details.



2.3.2. Front Panel Controls and Indicators

7. Systolic pressure display: 3-digit red LED indicates measured systolic BP in mmHg.

8. Active temperature probe holster: Temperature probe that is being used stored here (Models 200 and 400).

9. Diastolic pressure display: 3-digit red LED indicates measured diastolic BP in mmHg.

10. Temperature probe cover storage: Box of probe covers stored here (Models 200 and 400).

11. Inactive temperature probe holster: Extra temperature probe stored here (Models 200 and 400).

12. Temperature display: 4-digit red LED indicates measured temperature (Models 200 and 400).

13. °C °F display: Indicates whether temperature is being displayed in degrees Celsius or Fahrenheit (Models 200 and 400).

14. External power indicator: Green LED indicates external power status and battery charging status of PRO Series Monitor.

15. Temperature probe connector: Temperature probe cable attaches here (Models 200 and 400).

16. ON/OFF switch: Controls on/off state of PRO Monitor; push for power on and push again for power off.

17. Battery power indicator: Yellow LED indicates operation and charge status of battery.

18. SpO_2 sensor connector: SpO_2 sensor extension cable attaches here (Models 300 and 400).

19. Mean arterial pressure display: 3-digit red LED indicates measured MAP in mmHg and shows instantaneous cuff pressure during BP determination.

20. SpO_2 pulse indicator: Yellow LED in heart symbol flashes to indicate that real-time pulse rate measurements are being derived from SpO_2 signals (Models 300 and 400).

21. Rotor: Used to highlight and select items in LCD menus; if monitor is off, pressing rotor will switch monitor on.

22. Pulse BPM display: 3-digit yellow LED shows pulse rate in beats per minute.

23. SpO_2 display: 3-digit red LED indicates oxygen saturation in % (Models 300 and 400).

24.SpO_2 motion/artifact indicator LED: For NELLCOR, LED Illuminates when motion artifact is detected (Models 300 and 400). For Masimo, LED illuminates when low perfusion or low signal quality is detected (Models 300 and 400).

25. LCD (liquid crystal display): Displays all alarms, user interface messages, and configuration options.

26. Alarm silence switch: Alternately mutes and enables audible alarms; when pushed once after alarm sounds (silence on), the switch illuminates to indicate that audible alarms have been silenced for 2 minutes.

27. AUTO BP key: Press to start Auto BP mode.

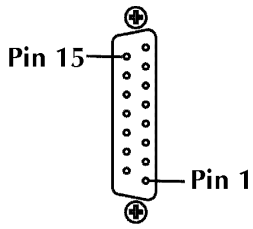
28. Light sensor: Automatically measures ambient light to set LED display intensity.

29. START/STOP BP key: Press to start or stop a BP, Auto, Stat, or Vitals determination.

30. Cuff connector: BP cuff hose attaches here.

Not Shown: The printer access door is located on the left side of the monitor. Push the latch to open the door and access the paper supply and print head. For details, see Section 5, Component Information.

2.4. HOST PORT CONNECTOR (REAR PANEL)



WARNING! Auxiliary equipment connected to the DINAMAP® PRO Series Monitor will result in the formation of an electromedical system and thus, must comply with the requirements of EN 60601-1-1/ IEC 601-1. All host port signals are NON-ISOLATED and should be connected to equipment conforming to IEC-601-1, configured to comply with IEC 601-1-1 ONLY. Where isolation of data communication is required, GE Medical Systems Information Technologies part number ILC232 should be used. If external alarm control is required, GE Medical Systems Information Technologies part number 487208 (Isolated Remote Alarm Cable Assembly) should ALWAYS be used. Please refer to the Information Sheet included with the isolated remote alarm cable for details.

Note: When using remote alarm, the PRO Series Monitor should be considered the primary alarm source. The secondary alarm is used for secondary purposes only.

Pin Assignments	
Pin	Function
1	Ground
2	Inverted TTL Transmit Data
3	Inverted TTL Receive Data
4	Fused +5 Volts
5	No connection
6	No connection
7	Ground
8	Remote Alarm
9	RS232 Request to Send (RTS)
10	RS232 Clear to Send (CTS)
11	RS232 Transmit Data (TxD)
12	No connection
13	RS232 Receive Data (RxD)
14	No connection
15	No connection

2.5. COMPATIBLE PARTS

Product	Product Code	ECAT
DINAMAP PRO Monitor Operations Manual-English	2009802-001	
DINAMAP PRO Monitor Service Manual-English	2009829-001	
Battery, 12V Lead Acid	633132	
Printer Paper (box of 10)	089100	E9050KP
DINAMAP Rolling Stand	003215	E9050JB
NIBP:		
Air Hose 12 ft Adult/Pediatric, Screw Connector	107365	E9050LH
Air Hose 24 ft Adult/Pediatric, Screw Connector	107366	E9050LJ
Air Hose 12 ft Neonatal	107368	E9050LK
CUFF Assortment Packs		
CLASSIC-CUF® Assortment Pack	2692	E2692J
Includes: 1 each: Infant, Child Small ADult, Adult, Large Adult, Thigh Cuff		
CLASSIC-CUF® Assortment Pack, Neonate	2693	E2695J
Includes: 2 Neo #1, 3 Neo #2, 5 Neo #3, 5 Neo #4, 5 Neo #5		
SOFT-CUF® Assortment Packs:	2695	E2695J
Includes: 1 Infant, 1 Child, 2 Small Adult, 2 Adult, 2 Large Adult, 1 Thigh, 1 Adult Long		
SOFT-CUF® Assortment, Neonate	2694	E2694J
Includes: 2 Neo #1, 3 Neo #2, 5 Neo #3, 5 Neo #4, 5 Neo #5		
DURA-CUF® Assortment Packs:	2699	E2699J
Includes: 1 each: Infant, Child, Small Adult, Adult, Large ADult, Thigh Cuff		
DURA-CUF® Assortment Pack, Adult	2698	E2698J
Includes: 1 each: Infant, Child, Small Adult, Adult, Large Adult, Thigh Cuff		
NIBP Calibration Kit	320246	
Additional Blood Pressure Cuff Codes are available through: http://www.gemedical.com		
TEMPERATURE		
IVAC® TURBO TEMP Kit (contains 615118 & 2008774-001)	2011530-001	
IVAC® TURBO TEMP Oral Temp Probe, Long Cord	2008774-001	

Product	Product Code	ECAT
IVAC® TURBO TEMP Rectal Temp Probe, Long Cord	2008775-001	
IVAC® Temperature Probe Covers	615118	E9050KK

IVAC is a trademark of ALARIS Medical Systems

SpO_2:

NELLCOR®:

Pulse Oximeter Cable DOC-10	2008773-001
DuraSensor Adult Oxygen Sensor	DS100A

NELLCOR is a trademark of Mallinckrodt, Inc.

Masimo®:

Masimo® SpO_2 Kit (contains 2009745-001 & 2009743-001)	2011605-001
Adult Reusable Sensor, 1/BX (NR125)	2009745-001
Cable (PC08)	2009743-001

Masimo SET® is a trademark of Masimo Corporation.

2.6. SPECIFICATIONS

CE This product conforms to the essential requirements of the Medical Device Directive. Accessories without the CE Mark are not guaranteed to meet the Essential requirements of the Medical Device Directive.

IPX1 The PRO Series Monitor is protected against vertically falling drops of water and conforms to the IEC 529 standard at level of IPX1. Vertically falling drops of water shall have no harmful effects to the Monitor.

2.6.1. Power Requirements

Mains	Protection against electrical shock - Class 1
AC Input Voltage	115/230 VAC, 50/60 Hz (nominal), 90~253 VAC, 47~63 Hz (range)
Alternate Sources	Protection against electrical shock - Class 1
DC Input Voltage	18-24 VDC, 30 VA from supplied power convertor
External DC Input Fuse	Internal, Auto-resetting
Battery	12-volt, 2.3 amp-hours. Protected by auto-resetting fuse. Minimum operation time: 2 hours (5 minute auto cycle with adult cuff at 25°C (77°F) from full charge. Time for full recharge: 1hr 50 min from full discharge when the Monitor is switched off and 8 hrs when the Monitor is switched on.

2.6.2. Environmental

Operating Temperature	+5° C to +40° C (+41° F to + 104° F)
Operating Atmospheric Pressure	700hPa to 1060 hPa
Storage Temperature	-20° C to +50° C (-4° F to + 122° F)
Storage/Transportation Atmospheric Pressure	500 hPa to 1060 hPa
Humidity Range	0% to 95%, noncondensing
Radio Frequency	Complies with IEC Publication 601-1-2 (April 1993) Medical Electrical Equipment, Electromagnetic Compatibility Requirements and Tests and CISPR 11 (Group 1, Class A) for radiated and conducted emissions.

2.6.3. Mechanical

Dimensions	Height: 9.8 in (25.0 cm) Width: 9.8 in (25.0 cm) Depth: 6.9 in (17.5 cm)
Weight, Including Battery	7.8 lb (3.5 kg)
Mountings	Self-supporting on rubber feet or pole mountable
Classification Information	Mode of operation: continuous Degree of protection against harmful ingress of water: Drip-proof IPX1

2.6.4. BP

Cuff Pressure Range (Normal operating range)	0 to 290 mmHg (adult) 0 to 140 mmHg (neonate)
Default Target: Cuff Inflation	160 ± 15 mmHg (adult) 110 ± 15 mmHg (neonate)
Target Cuff Inflation: Adjustment Range (5 mmHg increments)	100 to 250 mmHg (adult) 100 to 140 mmHg (neonate)
Blood Pressure Measurement	
Adult	Range (mmHg)
Systolic	30-245
MAP	15-215
Diastolic	10-195
Neonate	
Systolic	40-140
MAP	30-115
Diastolic	20-100
Blood Pressure Accuracy	Meets or exceeds ANSI/AAMI standard SP-10 (mean error ≤5 mmHg, standard deviation ≤8 mmHg)
Maximum Determination Time	120 seconds (adult) 85 seconds (neonate)
Overpressure Cutoff	300 to 330 mmHg (adult) 150 to 165 mmHg (neonate)
Pulse Rate Range	30 to 200 beats/min (adult) 30 to 200 beats/min (neonate)
Pulse Rate Accuracy	±3.5%
US Patents: 4,360,029; 4,501,280; 4,546,775; 4,638,810; 5,052,397; 4,349,034; 4,543,962; 4,627,440; 4,754,761; 5,170,795	
European Patents	EP122123, EP205805, EP207807

2.6.5. TURBO TEMP

Scale	°Farenheit (F) °Celsius (C)
Range	
Predictive Mode	Max: 41.1° C; 106.0° F Min: 33.6° C; 96.0° F
Monitor Mode	Max: 41.1° C; 106.0° F Min: 26.7° C; 80.0°
Predictive Mode Accuracy	± 1.0° F ± 0.6° C
Monitor Mode Accuracy	± 0.1° C ± 0.2° F (when tested in a calibrated liquid bath; meets ASTM E1112, Table 1, in range specified)
Determination Time	less than 60 seconds

Use only IVAC probes and probe covers. The size, shape, and thermal characteristics of the probe covers can affect the performance of the instrument. Inaccurate readings or retention problems may occur unless IVAC probes and probe covers are used.

IVAC® Patents	U.S. D300,728; D300,909

2.6.6. SpO_2

NELLCOR SpO_2

Measurement Range	
SpO_2	1 to 100%
Pulse Rate	20 to 250 beats per minute
Perfusion Range	0.03 to 20%
Accuracy and Motion Tolerance	
Saturation	
Without Motion - Adults*	70 to 100% ±2 digits
Without Motion - Neonate*	70 to 100% ±3 digits
With Motion - Adults/Neo**	70 to 100% ±3 digits
Low Perfusion	70 to 100% ± 2 digits
Pulse Rate	
Without Motion	20 to 250 beats/min ±3 digits
With Motion	normal physiologic range 55 to125 beats/min ±digits

Low Perfusion	20 to 250 beats/min ±3 digits

* Adult specifications are shown for OXIMAX MAX-A and MAX-N sensors. Neonate specifications are shown for OXIMAX MAX-N. Saturation accuracy may vary by sensor type.

** Applicability: OXIMAX MAX-A, MAX-AL, MAX-P, MAX-I, and MAX-N sensors.

Default Settings

SpO_2 (%)	HIGH: 100
SpO_2 (%)	LOW: 90
Response Mode	2 (for Mode 2: Fast Response)
Sat Seconds	0
Audible indicator	Pitch changes continuously with saturation; volume from 0 (off) to 9
Waveforms	Pulse plethsysmograph waveform on LCD gain compensated
Sensor Connect/Disconnect From Patient	Monitor detect attachment or disconnection of sensor from patient within 15 seconds.
Pulse Detection	Monitor will detect pulse or enter no signal state within 15 seconds of being attached to patient
Loss of Pulse	Monitor will detect loss of pulse from patient and enter no signal state within 10 seconds
Sensor Light Source	
Wavelength	Infrared: 890 nm (nominal) Red: 660 nm (nominal)
Power Dissipation	52.5 mW (max)

Nellcor Patents
4,621,643; 4,653,498; 4,700,708; 4,770,179; 4,802,486; 4,869,254; 4,928,692; 4,934,372; 5,078,136; 5,351,685; 5,421,329; 5,845,847; 5,533,507; 5,577,500; 5,803,910; 5,853,364; 5,865,736; 6,083,172; Re. 35,122 and, international equivalents.

Masimo SET SpO_2

Measurement Range

SpO_2	1 to 100%
Pulse Rate	25 to 240 beats/min
Perfusion Range	0.02 to 20%

Accuracy and Motion Tolerance

Saturation

Without Motion - Adult/Ped*	70 to 100% ±2 digits
Without Motion - Neonate*	70 to 100% ±3 digits
With Motion - Adult/Ped/Neo**†	70 to 100% ±3 digits

Low Perfusion‡	70 to 100% ±2 digits 0 to 69% unspecified

Pulse Rate

Without Motion	25 to 240 beats/min ±3 digits
With Motion	normal physiologic range 25 to 240 beats/min ±5 digits

*The Masimo SET®® SpO2 parameter with LNOP-Adt sensors has been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

**The Masimo SET® SpO2 parameter with LNOP-Adt sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non repetitive motion before 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

†The Masimo SET® SpO2 parameter with LNOP-Neo Pt sensors has been validated for neonatal motion accuracy in human blood studies on neonates while moving the neonate's foot at 2 to 4 cm against a laboratory co-oximeter and ECG monitor. This validation equals plus or minus, one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

‡The Masimo SET® SpO2 parameter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus, one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

Masimo® Sensor Accuracy

Sensor Model	SpO2 range 70%- 100%
LNOP	±2 digit
LNOP-ADT	±2 digit
LNOP-ADT Long	±2 digit
LNOP-PDT	±2 digits
LNOP-NEO	±3 digits
LNOP-NEO PT	±3 digits
LNOP-DCI (reusable)	±2 digits
LNOP-DCSC (reusable)	±2 digits
LNOP-DCIP (reusable)	±2 digits
NRI25 (reusable)	±2 digit

Resolution

Saturation (% SpO2)	1%
Pulse Rate (bpm)	1

Low Perfusion Performance

>0.02% Pulse Amplitude and % Transmission >5%	Saturation (% SpO2) ±2 digits Pulse Rate ±3 digits

Interfering Substances

Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substance containing dyes, that change usual arterial pigmentation may cause erroneous readings.

Sensor Light Source

Wavelength	Infrared: 905 nm (nominal)
	Red: 660 nm (nominal)
Power Dissipation	Infrared: 22.5 mW (max)
	Red: 27.5 mW (max)

Default Settings

SpO2 (%)	HIGH: 100
SpO2 (%)	LOW: 90
Sensitivity Mode	2 (for low perfusion-Default)
Averaging Time	12 seconds
FastSAT Mode	0 (for Off)

Masimo Patents
5,482,036; 5,490,505; 5,632,272; 5,685,299; 5,758,644; 5,769,785; 6,002,952; 6,036,642; 6,067,462; 6,206,830; 6,157,850, and international equivalents.

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3 Theory of Operation

For your notes

Table of Contents

3.1. Introduction 3-5

3.2. Overall Theory Of Operation 3-5

3.2.1. Cuff Blood Pressure (BP) and Pulse 3-5

3.2.2. Temperature (Model 200 and 400) 3-6

3.2.3. SPO2 (Model 300 and 400) 3-6

3.2.4. Host Communication Port 3-6

3.3. Functional Description 3-7

3.3.1. PSU PWA 3-7

3.3.2. PSU Module 3-7

3.3.3. Main Board 3-7

3.3.4. SPO2 PWA (Optional) 3-8

3.3.5. Pneumatic Control Device 3-9

3.3.6. LCD Assembly 3-9

3.3.7. Printer PWA w/Printer 3-9

LIST OF FIGURES

3-1 General System Diagram 3-11

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3.1 INTRODUCTION

This section provides overall theory of operation and functional description of the DINAMAP PRO Monitor (hereinafter referred to as PRO Monitor). The PRO Monitor comes in four different models, as follows:

- PRO Monitor 100 - It has the capability of monitoring Blood Pressure (BP) and Pulse
- PRO Monitor 200 - It has the capability of monitoring BP, Pulse, and Temperature
- PRO Monitor 300 - It has the capability of monitoring Blood Pressure (BP), Pulse, and SPO2
- PRO Monitor 400 - It has the capability of monitoring BP, Pulse, Temperature, and SPO2

3.2 OVERALL PRINCIPLES OF OPERATION

The following paragraphs provide a general system interface relationship. The general block diagram is located in Figure 3-1.

The PRO Monitor is a portable unit that receives input power from an external AC source, external DC source, or internal rechargeable battery.

When the ON/OFF button is pressed, the Main Board is brought out of a sleep mode and turns on the power regulators. The power regulators provide conditioned power from one of the input power sources: AC Mains, External DC, or the Lead Acid Battery. The regulated power is routed to the Printed Wiring Assemblies (PWAs) via the cable harnesses. Once the Pro Monitor is energized, a self-test is performed. The self-test automatically tests the main functions of the PRO Monitor. Failure of the self-test will set the PRO Monitor into a fail-safe mode with an audio alarm.

Under normal operating condition, the PRO Monitor is ready to record the patient vital signs using three external attachments: the temperature probe, SPO2 sensor, and cuff. Interface with a central station or other device is accomplished through the host communication port on the back of the Pro Monitor.

3.2.1 Cuff Blood Pressure (BP) and Pulse

When the cuff and hose are attached to the Pro Monitor and Non-Invasive Blood Pressure (NIBP) determination is initiated, the pump inflates the cuff. Pressure transducers PT1 and PT2 monitor pressure information. The pneumatic manifold has two valves, which are used to deflate the cuff. Valve control is through the Main Board. Once determinations are made for the systolic BP and diastolic BP, the

Main Board calculates the pulse rate/Mean Arterial Pressure (MAP). The results are then displayed on the front panel (seven segment Light Emitting Diodes (LEDs) and sent to the printer.

The Pneumatic Valve/Manifold (PVM) device has an overpressure sensor built-in to protect against over-inflation. If an over-inflation condition occurs, the OVERPRESSURE signal is routed to the PVM to release the air pressure. The Main Board also, generates an alarm condition with the speaker sounding and a message in the Liquid Crystal Display (LCD).

3.2.2 Temperature (Model 200 and 400)

The PRO Monitor uses Alaris Turbo Temp technology to measure patient temperature. The Turbo Temp probe contains a heating element that pre-heats the probe to reduce determination time. The heating function is controlled by the Main Board. The Turbo Temp probe also contains a thermistor that indicates the temperature. When the probe is attached to the temperature connector and patient, the signal generated by the thermistor is routed to the Main Board. The Main Board converts the thermistor signal along with status information (i.e ORAL or RECTAL probe indicators) to a DIGITAL signal. The Main Board then processes the DIGITAL signal and displays the patient temperature on the UI Board and printer in Celsius or Fahrenheit.

3.2.3 SPO2 (Model 300 and 400)

The SPO2 probe has a built-in sensor. When the SPO2 sensor is attached to the SPO2 connector and patient, the probe senses the heart rate and oxygen saturation. These analog signals are routed to the SPO2 PWA. The analog signals are analyzed on the SPO2 PWA. The results are digitized and sent to the Main Board via opto couplers. The couplers provide for patient isolation as well as serial data interface. The Main Board processes the data and routes it to the appropriate displays and/or printer.

A reset signal to the SPO2 PWA is also provided so that the power up sequencing is corrected. If the SPO2 circuit quits communicating to the Main Board, the Main Board will attempt to reset the SPO2 PWA.

3.2.4 Host Communication Port

The Host Comm Port is used to interface the Monitor with other electronic devices (a central nurse’s station or remote alarm device.) Signals can be sent to the Monitor to initiate blood pressure determinations and other functions. Patient data can also be retrieved through this port. For further information, reference the DINAMAP PRO 100-400 Series Host Communication manual.

3.3 FUNCTIONAL DESCRIPTION

The following paragraphs provide the functional interface relationship. The Pro Monitor contains a number of electrical & electro-mechanical assemblies. These assemblies are:

- Power Supply Unit (PSU) PWA
- PSU Module
- Main Board
- SPO2 PWA (optional)
- Pneumatic control device
- Liquid Crystal Display (LCD) Assembly
- Printer PWA w/printer

3.3.1 PSU PWA

The PSU PWA is a low voltage DC power supply. The PSU PWA is designed to operate from the output of the AC MAINS PSU module, EXTERNAL DC line source, or from a 12-volt rechargeable lead-acid battery. When the PSU PWA receives the EXTERNAL DC, a portion of that voltage is routed to an analog input of the Secondary Processor. The Secondary Processor uses this signal to determine the available power sources. If a valid external power source is available, LED lights to indicate that external power is available. If an external power source exists, and a battery source is detected, the Secondary Processor will send a command to turn on the Battery Charger circuitry. If there is no external power source or the external power source is below the required voltage, the PSU PWA will automatically default to use the battery. Since the Pro Monitor is now operating from the battery voltage, a sample of the battery source is applied to Analog Digital Converter (ADC) circuit of the Secondary Processor. From this, the Secondary Processor can determine the charge state of the battery.

3.3.2 PSU Module

The PSU module is an AC Mains to DC converter. The PSU module receives AC power from an external source. When AC INPUT is applied to the PSU module, the module AC/DC Converter changes the AC INPUT supply via rectifier circuit to a high voltage DC. The DC power is then routed through a high frequency switching converter and regulated to 24 vdc. This supply is connected to the PSU PWA for further regulation.

3.3.3 Main Board

The Main Board is configured with Programmable Read Only Memory (PROM), Random Access Memory (RAM), LED Display, Hard Keys,

16 Bit ADC, Primary Processor, and Secondary Processor. The Primary Processor services and controls the Patient Parameter Interface (PPI) devices and display backlighting. The Secondary Processor controls the seven segment LED display, sound generation, real time clock, and system timing verification. The processors receive DC power from the PSU PWA. When the PPI devices transmit analog data to the Main Board A/D converter, the Primary Processor perform algorithm calculations. Once all the calculated parameter values are compiled, the data is then transmitted to the LCD and printer via Secondary Processor. Concurrently, the calculated parameter values are being stored in the non-volatile RAM. Calibration and other variable settings are stored in the Electrically Erasable Programmable Read Only Memory (EEPROM).

The Main Board backup voltage, derived from either NiMH battery or an external power source, appears on the Main Board supervisory circuit. The Main Board supervisory circuit generates the RESET and HALT signal for the Primary Processor. It also, allows EXTERNAL DC voltage to the RAM and Secondary Processor when the system is ON or battery backup voltage to power the RAM and Secondary Processor when the system is OFF.

If the Primary Processor fails to reset its watchdog timer, the Primary Processor sends a low level on its watchdog output to the Pneumatic Control Gate Array Logic (PCGAL). If the Primary Processor detects system faults or overpressure, it will notify the Secondary Processor of system failure condition. The Secondary Processor in turn, sends a FAILSAFE signal to the PCGAL and Tone Generator. When the PCGAL receives the FAILSAFE signal, it sends a DEFLATE signal to the Pneumatic Valves to depressurize the system to atmosphere. Once the Tone Generator receives the FAILSAFE signal, it sends an audio frequency (ALARM signal) to the speaker. During the fail-safe mode the following will also occur:

- Parameter monitoring disabled
- Remote alarm control inactive
- Graphic LCD displays fault error code
- Pneumatic safe state (deflate the cuff, pump off)
- Normal communications interface disabled
- Hard keys and rotary switch inactive

When a low or high ambient room lighting occurs, the Primary Processor uses it’s supervisory circuit to increase or decrease the graphic backlighting, automatically.

3.3.4 SPO2 PWA (Optional)

The SPO2 PWA provides continuous readings of oxygen saturation and pulse rate. Additional circuitry provides power, data

communications, and isolation between SPO2 PWA and Primary Processor.

Patient data received from the finger sensor is filtered, amplified, and analyzed on the SPO2 PWA. The information is sent to the Main Board via the optically coupled electrically isolated serial connection. The Primary Processor receives the data and distributes it to the appropriate display. The data is also sent to the printer via the Secondary Processor.

3.3.5 Pneumatic Control Device

The Main Board transducers PT1 and PT2 sense cuff pressure and raw oscillatory information. The analog signals are amplified, buffered, and sent to an Analog to Digital (A/D) Converter. The converter changes the analog signals to digital signals and routes these signals to the Primary Processor. The Primary Processor receives the digital signals via the data interface.

Appropriate valve and pump control signals are sent from the Primary Processor to the PCGAL. The PCGAL then generates the appropriate drive signals to the pump and valves.

If a fail-safe mode or overpressure condition occurs, the PCGAL provides the appropriate control signals to insure a safe condition, where the cuff vents to atmosphere pressure.

3.3.6 LCD Assembly

The LCD assembly is used as a message center. It displays patient vital signs, alarm status, monitor set-up, limit violation, BP cycle and the time the data was received. The Primary Processor controls the LCD assembly. When the parameter signals are read by the Primary Processor, it decodes these signals and routes the digitized signals to the graphic LCD.

The LCD assembly is equipped with a variable lighting feature for the graphic display. The Primary Processor controls the lighting feature, automatically. When a low or medium ambient lighting condition occurs, the Primary Processor sends a BACKLIGHT signal to adjust the graphic display lighting with respect to the room lighting condition. If the lighting condition is high, the Primary Processor sends a BACKLIGHT_1 signal to switch off the graphic display lighting.

3.3.7 Printer PWA w/Printer

The Printer PWA w/printer communicates to the Primary Processor via Secondary Processor data line. The printer receives power from the Main Board via the Printer PWA. The printer sends a DATA OUT (CONTROL DATA) signal to the Secondary Processor to notify of it’s

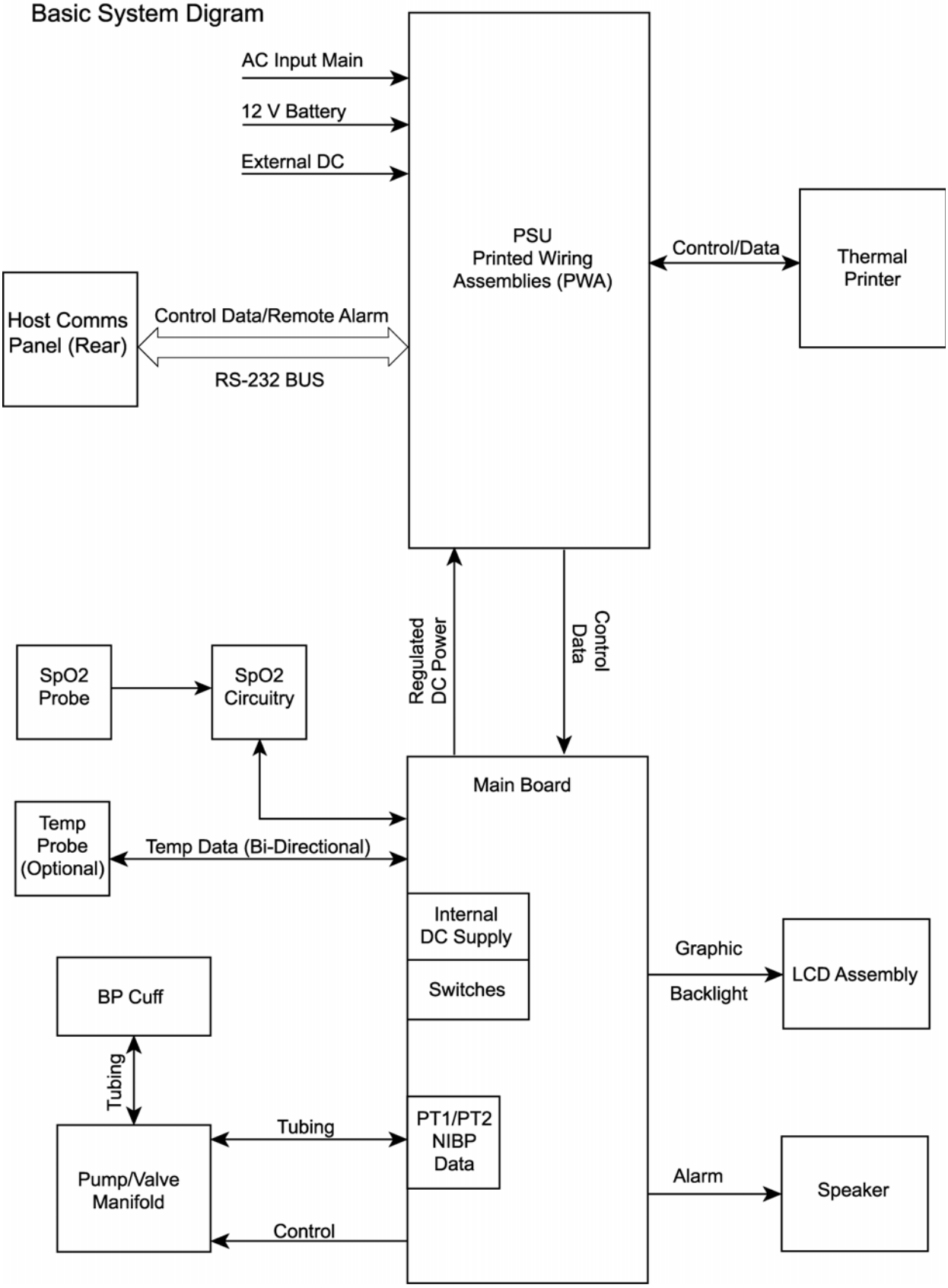
presence. When a print command is sent to the printer from the Secondary Processor, the following will occur:

- CLOCK signal - transfer the data into print head
- DATA IN - serial dot to be printed
- LATCH signal - latch the data stream into the head
- STB1-6 - cause the head to print various sections

Together these signals (CONTROL DATA) cause the printer to print a graphic hardcopy of the patient vital sign values and trend data. It also causes the printer to print hardcopy of error logging and service record data.

The printer has a built-in sensor to monitor the printer paper level. When the printer is out of paper, it sends a PAPER OUT signal to the Secondary Processor.

Figure 3-1
Basic System Digram



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4 Calibration & Maintenance

For your notes

Table of Contents

4.1. Introduction 4-5

4.2. Fuses 4-5

4.3. Periodic Maintenance 4-5

4.3.1. Cleaning the Monitor 4-5

4.3.2. Power Up Checks 4-6

4.3.3. External DC Supply and Battery 4-7

4.3.4. Care Of The Storage Battery 4-7

4.3.5. Checking NIBP Calibration 4-7

4.4. Clinician Mode 4-8

4.4.1. Accessing the Clinician Mode 4-8

4.4.2. Clinician Mode Main Menu 4-9

4.4.3. Clinician More...Menu 4-10

4.5. Service Mode 4-11

4.5.1. Accessing the Service Mode 4-11

4.5.2. Service Mode Main Menu 4-12

4.5.3. NIBP Menu 4-13

4.5.4. System Menu 4-14

4.6. Pre-Service Test Procedures 4-16

4.6.1. SpO_2 Checks (PRO 300 & 400) 4-16

4.6.2. Leak Test 4-17

4.6.3. NIBP Calibration Check 4-18

4.6.4. Neonate Overpressure Check 4-19

4.6.5. Adult Overpressure Check 4-20

4.6.6. Temperature System Check (PRO 200 and 400) 4-20

4.6.7. Printer Test 4-21

4.7. PRO Monitor Calibration Procedures 4-21

4.7.1. Calibrating the NIBP Transducer 4-21

4.7.2. Overpressure Adjustment 4-22

4.8. Electrical System Safety Checks 4-25

SECTION 4. GENERAL MAINTENANCE

4.1 INTRODUCTION

This section contains maintenance procedures for the DINAMAP® PRO Series 100-400 Monitor, including description of the software screens and menus used to adjust, configure and check the Monitor. Also included are procedures to recalibrate the Monitor.

Procedures pertaining to SpO_2 and temperature functions apply only to PRO Monitors equipped with these features.

4.2. FUSES

The PRO Monitor power circuits incorporate five fuses. None of the fuses are externally accessible. Two mains fuses are mounted on the AC mains converter board, and are not serviceable by the user.

If a mains fuse blows, the Monitor will not change from battery power to mains power when it is plugged in to an AC power source. To confirm a fuse problem, remove the battery, plug the unit in, and turn it on. If the PRO Monitor does not operate, the probable cause is an open fuse. Mains fuses should be replaced by a qualified service technician.

The other three fuses are:

- FS1 - Self resetting; DC input; PSU board
- FS2 - Self resetting; battery; PSU board
- FS3 - Self resetting; host port power; PSU board

4.3. PERIODIC MAINTENANCE

Periodic maintenance tasks include cleaning the PRO Monitor, checking pressure calibration, pneumatic leakage, pneumatic system overpressure point, temperature calibration (200 and 400), and verification of the SpO_2 system (300 and 400).

The exterior of the PRO Monitor may be wiped clean with a cloth slightly dampened with mild detergents or standard hospital bactericides.

4.3.1 Cleaning the Monitor

Cleaning with isopropyl alcohol or similar solvents is not recommended.

Do ***not*** immerse unit.

Do ***not*** immerse hoses.

Do ***not*** immerse cuffs without prior application of cuff hose caps.

CAUTIONS
Moisture or foreign substances introduced into the pneumatic system will cause damage to the unit. Calibration equipment should always be kept dry and clean.

4.3.2. Power Up Checks

When the PRO Monitor is powered up, it conducts a series of self-tests to ensure the displays and other functions are operating normally. Some malfunctions generate fatal errors and put the Monitor in fail-safe mode. In this mode, the patient monitoring features are disabled. Other malfunctions do not interfere with normal operation, but should be repaired at the next opportunity.

As part of a periodic maintenance routine, observe the power-up self-tests, and service as required.

LED Display Check
All seven segments of the LED digits are illuminated during the power up sequence. The segments light in a sequence beginning with the upper left segment.

LCD Display and LCD Backlight Check
Observe the LCD during power up. Confirm that all of the pixels on the LCD display are lit momentarily and the backlight is powered during initialization. The backlight is only noticeable in a dimly lit room. Confirm that the display indicates the software version in inverted format (white on black).

NIBP Calibration Check
If the NIBP system is uncalibrated, the Monitor turns on directly into service mode and displays a service menu. Refer to 4.7 PRO Monitor Calibration Procedures.

Speaker Check
During power up, the audio system generates three short beeps, followed, after a brief pause, by three more beeps. If the speaker generates distorted sounds or no sound, it is faulty.

Remote Alarm Switching Check
When the PRO Monitor is off, the remote alarm switches to an alarm state. The system clears the alarm state during power up. If the remote alarm does not change states, it is faulty.

4.3.3. External DC Supply and Battery

The power indicators on the lower left on the front of the PRO Monitor show the power source and charge status of the battery. The external power indicator LED continuously glows green to show the battery is charging.

The indicator flashes every four seconds to show an external power source is connected, but is not charging the battery. Either a battery is not installed or the external DC input voltage is too low.

Checking the Battery

1. Power on, and wait for the PRO Monitor to initialize. Confirm the external power indicator is lit and the battery LED is off.

2. Remove the battery and confirm that external DC LED on the Monitor flashes.

3. Fit the battery and disconnect the external power supply. Confirm the external power indicator is off; the battery LED glows yellow; and the battery icon appears on the LCD, toggling with the time indicator. If the battery power is low, the battery LED flashes every four seconds and the battery icon on the LCD changes.

4. Reconnect the external power supply, and verify that the battery LED is off.

4.3.4. Care of the Storage Battery

It is best to keep the battery charged as fully as practical. Never store the Monitor with the battery in a discharged condition. When the battery no longer holds a charge, remove and replace with one of the same part number.

- To ensure that the battery is ready for portable operation, keep the unit connected to AC mains whenever possible.
- Repeated failure to fully charge the battery significantly reduces battery life.
- Avoid storing batteries at temperatures above 77° F (25° C). High storage temperatures can dramatically increase the self-discharge rate of battery.

4.3.5. Checking Calibration

Perform the test procedures described in 4.6 whenever the accuracy of any of the parameters is in doubt.

The PRO Monitor provides a special mode named Clinician Mode. This mode is accessed from the **More…** option on the Main menu, and requires a code before a user can access it.

4.4 Clinician Mode

The **Clinician Mode** enables the user to:

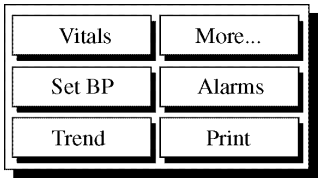
- Verify NIBP calibration dates
- Change the alarms to “Permanent Silence” mode
- Set target inflation pressure

This section provides an overview of the Clinician menus. For more information and details of operation, see the *PRO Series 100-400 Monitor Operation Manual.*

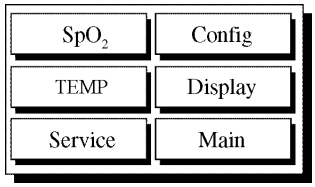
4.4.1 Accessing the Clinician Mode

To enter Clinician Mode from the Main menu, use the rotor control and LCD.

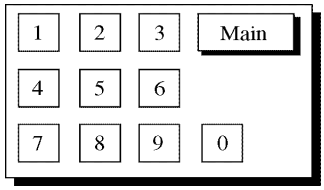
1. Select the **More…** button.



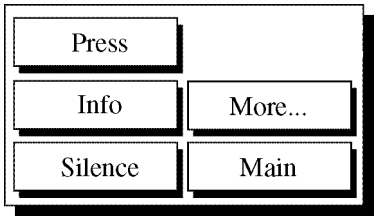
2. Select the **Service** button.



3. Clinician Mode requires a four-digit code. Turn the rotor to highlight a number, and push to make a selection. Enter access code: ***1 2 3 4.***

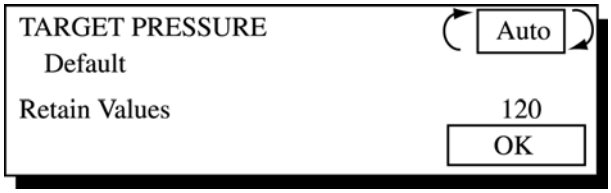


4.4.2. Clinician Mode Main Menu

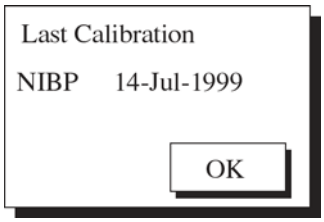


The Clinician Mode Main menu, pictured above, provides access to the options normally required for routine use of the PRO Monitor. The individual buttons on this menu are described briefly below.

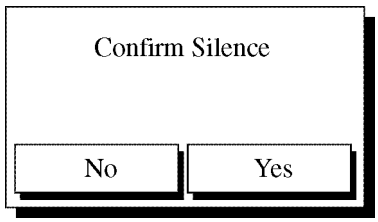
Press Button



Selecting the **Press** button displays the target pressure dialog box, pictured above, which sets the default target inflation pressure for a BP cycle. The factory default is 160 mmHg for adults and 110 mmHg for neonates. This is indicated by the “Auto” label at either end of the adjustable range. Choosing “Retain Values” allows the user to preset the number of minutes for which displayed values are retained on the Monitor.



Selecting the **Info** button displays the most recent calibration dates of the BP. Choose **OK** to return to the Service menu.



Selecting the **Silence** button displays the dialog box, pictured above, which mutes **all** the alarms except the fail-safe alarm. The alarms are disabled until the Monitor is either powered off and on again or the

Silence button is pressed. Choosing either **Yes** or **No** will exit the menu. If silence is confirmed, the Alarm Silence button lights.

More... Menu Button

The More... menu accesses more options that allow the user to permanently change the default settings.

Main Button

Select this button to exit the Service menu and return to the Main menu.

4.4.3. Clinician More... Menu

The Clinician More… menu accesses the options to change the default settings of several PRO Monitor functions. These options are summarized below.

Trend Button

Displays a dialog box to automatically clear trend data on power up. The default setting is **Yes**. In the default setting, trend data is cleared when the PRO Monitor is shut off. Select **No** to retain the trend data on power-down.

Print Button

Displays a dialog box to restore the print mode on power up to the user-selected print mode (auto or manual) or the default print mode. The print mode can be selected through the Print button on the Main menu. The current mode is displayed in the lower right corner on the LCD. Select **No** and the PRO Monitor powers up in manual print mode. Select **Yes**, and the monitor retains the user-selected mode.

Set BP Button

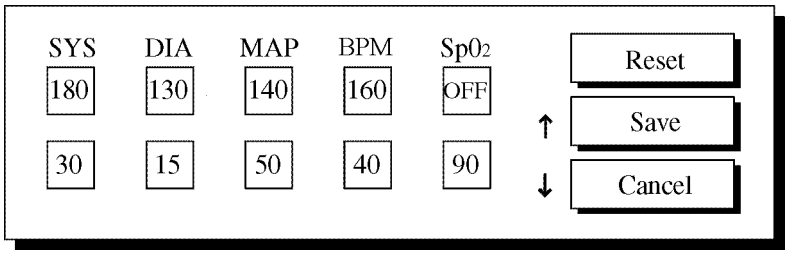
Displays a dialog box to power up in a user-selected BP mode (auto/ manual). Select **Yes** to preserve the user-selected BP mode. Select **No** to power up the PRO Monitor in manual mode.

SpO_2 Button

Selecting **Yes** enters the SpO_2 configuration menu. Selecting **No** returns the user to the More… menu. This menu displays a dialog box that enables the user to adjust the sensitivity of the SpO_2 parameter and to enable the FastSAT Feature (if equipped.)

Alarms Button

This button accesses a dialog box to enter the alarms configuration menu**.** Selecting **Yes** enters the menu. Selecting **No** returns the user to the More… menu.



Select **Reset** to return all the alarm limits to the default settings. The illustration above shows the default settings.

The user can adjust the alarm limits within the ranges specified in the table below. The high limit must be at least one step higher than the low limit.

Parameter	Range	Default
Systolic High	35 - 245	180
Systolic Low	30 - 240	30
Diastolic High	15 - 195	130
Diastolic Low	10 - 190	15
MAP High	20 - 215	140
MAP Low	15 - 210	50
Heart Rate High	35 - 250	160
Heart Rate Low	30 - 245	40
$Sp0_2$ High	51 - 100	Off
$Sp0_2$ Low	20-99	90

Note: Predictive temperature has no alarm limit alarm.

Select **Save** to save the displayed settings and return to the More… menu. Select **Cancel** to abandon any changes and return to the More… menu.

4.5. SERVICE MODE

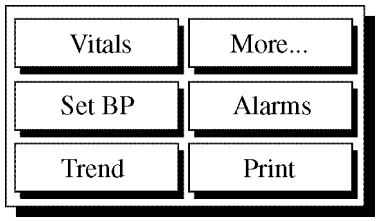
The **Service Mode** provides the same features as the Clinician Mode and adds these functions:

- Check the BP calibration
- Re-calibrate BP
- Adjust the pneumatic system overpressure point
- Configure communications with a host computer
- Change the language of operation

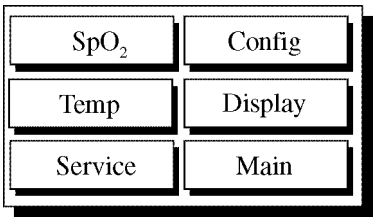
4.5.1 Accessing the Service Mode

To enter Service Mode from the Main menu, use the rotor and LCD.

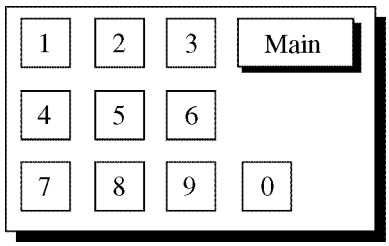
1. Select the **More…** button.



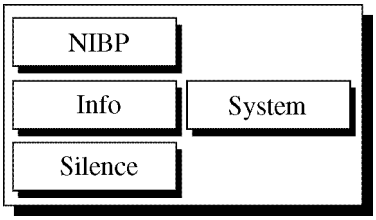
2. Select the **Service** button.



3. The service menu requires an access code. Turn the rotor to highlight a number, and push to make a selection. Enter access code **2 2 1 3**.



4.5.2 Service Mode Main Menu



The options accessed through the Main Service menu, pictured above, allow the technician to check basic functions of the PRO Monitor, calibrate the NIBP system, and set the language of operation.

Note: These menus and adjustments should be used only by qualified service technicians.

NIBP Button

The NIBP button accesses the NIBP Service menu. Use this menu to calibrate and check the NIBP transducers and the overpressure circuitry (Section 4.5.3).

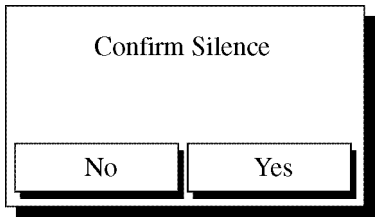
Info Button

This button displays the date of the most recent NIBP calibration. Select **OK** to return the display to the Service menu.

System Button

This button accesses the System menu. The options on this menu set the display language, communications protocols, test the EEPROM, and print the error log (Section 4.5.4).

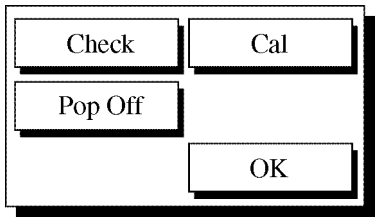
Silence Button



Selecting the **Silence** button displays a request to confirm the choice. This is a working option available only through the Clinician Mode (1234). Alarms are disabled when in Service Mode.

Yes mutes *all* patient alarms until the PRO Monitor is powered off and on again or the alarm Silence button is selected again to enable the alarms. A confirmation menu appears (pictured above) on the display. Selecting either **Yes** or **No** exits the menu. If silence is confirmed, the alarm Silence button on the front panel illuminates momentarily.

4.5.3. NIBP Menu



The options on the NIBP menu, pictured above, are used to calibrate and test BP functions of the PRO Monitor.

Check Button

This button allows the NIBP calibration to be checked. In this mode, the Monitor functions as a digital manometer. The systolic LED displays the output of PT1, and the diastolic LED displays the output of PT2.

With no hose attached, the systolic and diastolic displays will indicate “000.” See Section 4.7 for a more detailed description of this mode and the calibration procedure.

Cal Button

This button initiates the calibration procedure. See Section 4.7 for a step-by-step description of this procedure.

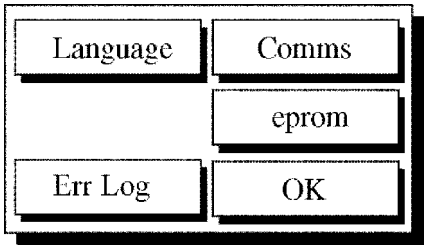
Pop Off Button

This button functions in a similar manner to the **Check** button, but the overpressure point is set to the neonate value. See Section 4.7 for a more detailed description of using this function.

OK Button

This button returns the display to the Main Service menu.

4.5.4. System Menu



The System menu, pictured above, accesses the options that modify the basic configuration of the PRO Monitor, test the EEPROM, and print the error log.

Language Button

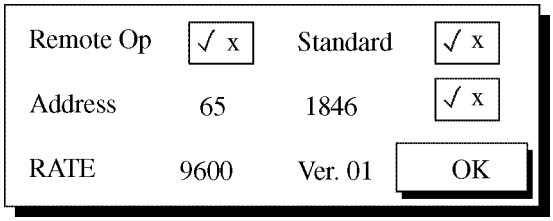
This button displays the language choices. The language dialog boxes are not pictured. The PRO Monitor software can display menus in five languages: UK, USA, German, French, and Spanish.

Selecting any language button removes all other language buttons from the screen, indicating that the remaining button is the chosen language. Selecting **Clear** restores all the language buttons, allowing the user to select again. **OK** saves the selection and a dialog box requests that the Monitor be turned off. If no language is selected when **OK** is pressed, the language is stored as undefined. In this

case, the Monitor prompts the user to select a language on every power up until a selection occurs.

Comms Button

This button accesses the Communications menu. The settings on this menu configure communications with a host computer when PRO Monitors are connected to a network.



The **Remote Op** check box toggles remote operation. When on, a check mark (√) appears in the box. When on, the PRO Monitor responds to external commands and can initiate a BP determination when prompted by a host computer. Remote operation requires DINAMAP® Host Communications Protocol, which is described in the *DINAMAP® Host Communications Reference Manual*.

The **Standard** check box sets the host comms protocol to standard format, and the baud rate at 9600 bps.

The **Address** box sets the Monitor address within a range of 32 to 126. Address 32 is not unique. All monitors, regardless of unit address, respond to commands to unit address 32.

Selecting the **1846** button sets the comms protocol to 1846 format, and the baud rate to 600 bps.

The baud **Rate** can be set to **300, 600, 1200, 2400, 4800, 9600,** or **19200**.

Select **OK** to return to the Main Service menu.

eprom Button (EEPROM Testing)

This button initiates a test of the read and write functions on the EEPROM. The test is repeated 20 times. The results are displayed on the LCD and recorded in the error log.

Err Log Button

This button generates a printout of the last 20 system errors that have occurred on the unit. The system and secondary processor software versions are also listed on the error log.

4.6. PRE-SERVICE TEST PROCEDURES

The following procedures can be used to check the primary functions of the PRO Monitor before releasing the unit for clinical service.

The Monitor is tested by applying various stimuli to the sensor interfaces or by measuring of specific parameters. The test procedures employ features of the operational software and test modes of the service menus.

A guide to the Monitor controls, indicators, and connectors is in Section 2 of the PRO Monitor service manual.

Test Equipment

1. Digital Pressure Gauge 0-375mmHg, 0.2% accuracy, Digitron P200L or similar.

2. NELLCOR® SpO_2 Simulator Model BIO-TEK INDEX 2 MF or similar for Nellcor SpO_2 or equivalent.

3. Biotek SpO_2 Simulator for Masimo® SpO_2 or equivalent.

4. NIBP Calibration Kit P/N 320246, or similar.

5. IVAC® Probe Simulator TE 1811.

Test Conditions

Testing shall be conducted with an ambient temperature of 25 °C ± 5 °C (77 °F ± 9 °F).

4.6.1. SpO_2 Checks (PRO 300 & 400)

For Monitors equipped with Nellcor SpO_2

On occasion when testing the integrity of the Nellcor oximetry system, abnormal results may occur when introducing large changes in the pulse rate and/or pulse amplitude. Extreme changes in rate sent to the Nellcor sensor by the SpO_2 simulator may cause the SpO_2 algorithm to completely miss finding the pulse rate.

This is an expected result. To work around this, incrementally step up or down the settings on your SpO_2 simulator and allow the Monitor to detect and display the new pulse rate or saturation.

Nellcor recommends use of the SRC-MAX Portable Tester for use with PRO Monitors equipped with the Nellcor SpO_2 system.

For Monitors equipped with Masimo SpO_2

Masimo recommends BIO-TEK SpO_2 simulators.

1. Connect the appropriate SpO_2 simulator and cable to the SpO_2 connector.

2. Verify the unit displays:

- Pulse value
- Saturation value
- Signal Strength bar graph

3. Disconnect the SpO_2 cable from the simulator.

4. Verify the unit generates an "SpO_2 SENSOR OFF" alarm and the speaker is sounding.

5. Press the **Silence** button.

6. Verify the sound has stopped but the error remains displayed.

7. Reconnect the SpO_2 sensor.

8. Verify the unit displays:

- Pulse Value
- Saturation value
- Signal Strength bar Graph

4.6.2. Leak Test

This test performs a leak test of the pneumatic system.

Equipment required:

- CRITIKON Adult blood pressure cuff (p/n 2774)
- 12 foot Gray, Adult/Pediatric Air Hose (p/n 107365)

1. Secure the Adult-size cuff to the 12-foot air hose. Attach to the PRO Monitor. Secure the BP cuff around a rigid, unbreakable object that measures at least 2" in diameter.

2. Ensure the index-line of the CRITIKON blood pressure cuff is properly aligned within the range-markers on the opposite end of the cuff.

3. Power on the PRO Monitor and select **More...**

4. Select the **Service** option and input **8 3 7 8.**

5. From the Super Service menu, select the **NIBP** option.

6. From the NIBP menu, select the **LEAK** option.

The leak test sequence closes both internal valves and initiates the pneumatic pump. The Monitor will self-pressurize the pneumatic setup to approximately 200 mmHg. After 5 seconds the target

pressure value will be displayed in mmHg on the LCD. The system will maintain the pressure for 36 seconds and will continue to display the pressure in the pneumatic system on the LCD screen. Confirm that the pressure has fallen no more than 10 mmHg while the system is pressurized.

4.6.3. NIBP Calibration Check

This procedure verifies the linearity and calibration for both pressure transducers (PT1 and PT2) over the range 0-250 mmHg.

To verify calibration it is necessary to have the following test equipment:

- 2-tube NIBP hose, 12ft, p/n 107365
- DINAMAP Adult BP cuff p/n 2774 (or equivalent)
- Calibration Kit p/n 320246 with a manual inflation bulb
- NIST calibrated single-tube manometer

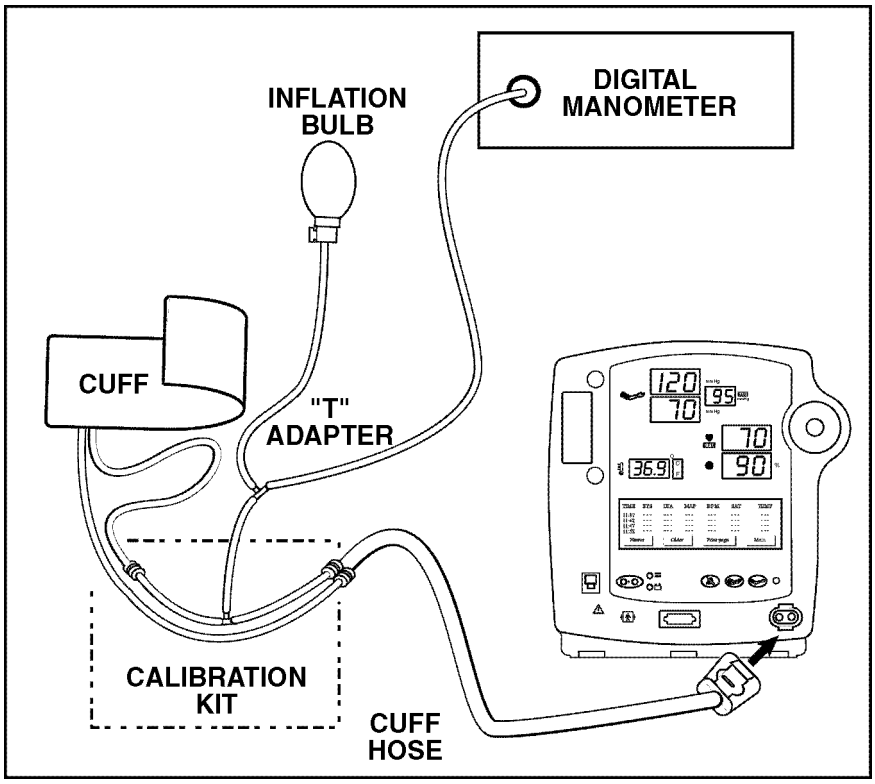


Figure 4-1

1. Set up the unit and calibration equipment as shown in Figure 4-1.

2. Power on the PRO Monitor and select **More...**

3. Select the **Service** mode and input **2 2 1 3**.

4. From the **Service** menu, select the **NIBP** button.

5. From the **NIBP** menu, select the **Check** button.

6. Apply the following pressures (measured by an external digital manometer) and confirm that the Monitor readings agree with the following table for both PT1 and PT2 channels.

7. If calibration is required, refer to Section 4.7.1.

PT1 & PT2 Linearity Check

Applied Pressure mmHg	Measured Pressure mmHg (at Monitor)
0	0 -0~+3
50	50 ±3
100	100 ±3
150	150 ±3
200	200 ±3
250	250 ±3

4.6.4.Neonate Overpressure Check

1. Set up the unit and calibration equipment as shown in Figure 4-1.

2. Power on the PRO Monitor and select **More...**

3. Select the **Service** mode and input **2 2 1 3**.

4. From the Service menu, select the **NIBP** button, then select the **Popoff** button.

Note: If the overpressure point is out of range, adjust the overpressure potentiometer as described in 4.7.2.

5. Increase applied pressure until overpressure occurs. Confirm that pressure at that point is between 150 mmHg to 165 mmHg and system pressure falls to less than 20 mmHg within 4 seconds.

6. Power off the PRO Monitor.

7. If calibration is required, refer to Section 4.7.1.

4.6.5. Adult Overpressure Check

1. Set up the unit and calibration equipment as shown in Figure 4-1.

2. Power on the PRO Monitor and select **More...**

3. Select the **Service** mode and input **2 2 1 3**.

4. From the Service menu, select the **NIBP** button.

5. Select the **Check** button.

6. Increase applied pressure until overpressure occurs. Confirm that pressure at the overpressure is between 300 mmHg and 330 mmHg and the system pressure falls to less than 20 mmHg within 8 seconds.

7. Switch off the PRO Monitor and disconnect the calibration kit.

8. If the Monitor fails this test, re-calibrate the unit as described in section 4.7.2.

4.6.6. Temperature System Check (PRO 200 & 400)

The PRO Monitor Series 200 & 400 temperature systems use ALARIS Model 2885 and 2886 temperature probes. This system is self-calibrating. The only maintenance required is to verify that the temperature functions are working properly. These checks require an IVAC probe simulator (P/N TE 1811), available from ALARIS Medical Systems, Inc., San Diego, CA. GE Medical Systems *Information Technologies* does not stock this tester.

To check the temperature system, connect the IVAC probe simulator to the temperature probe connector on the front panel, and insert a temperature probe into the active holster.

1. Power on the PRO Monitor.

2. Remove the temperature probe from the probe holster to initiate a temperature reading.

Set the probe simulator to 98.6 and verify that the LCD temperature display reads 98.6°F ±1.0°F. The numbers on the temperature LED displays should be flashing at this point, indicating the monitor is in a real-time monitor mode.

A range of temperatures can be checked, by using the other values on the probe simulator (98.0, 80.2, 102.0, and 107.8).

Broken Probe Sensing

Set up the equipment and the probe simulator as in the previous procedure. Rotate the temperature selector on the temperature simulator to B.P. verify that the Temperature display reads 106.0°F

±0.2°F. Next. press BROKEN PROBE on the simulator, verify that the LED display on the Monitor changes to four dashes, indicating a fault condition.

If the PRO Monitor temperature system does not pass these tests, the Main PWA needs to be replaced.

4.6.7. Printer Test

This test generates a sample printout from the printer. If no paper is in the printer, the Monitor generates no alarm.

1. Power on the PRO Monitor and select **More...**

2. Select the **Service** button and input **8 3 7 8**.

3. From the Super Service Menu, select the **Print** button,

Ensure the printed test page is clear and easy to read.

4.7. PRO MONITOR CALIBRATION PROCEDURES

Calibration procedures include calibration of the transducers and adjustment of neonatal and adult overpressure points. These tests require a manometer and a pump attached to the PRO Monitor as shown in Figure 4-1.

The following procedure describes the steps required to calibrate the pressure transducer. Disassembly is not required.

4.7.1. Calibrating the NIBP Transducer

1. Set up the Monitor and calibration equipment as shown in Fig. 4-1.

2. Power on the PRO Monitor.

3. Verify that calibration equipment reads 0 mmHg of pressure.

Note: If the PRO Monitor displays the language choice menu, select a language. Select **OK** and reboot the system.

4. Select the **More…** button from the Main menu.

5. Select the **Service** button.

6. Enter the Service Mode access code **2 2 1 3**.

7. Select the **NIBP** button from the Service menu.

Important: From this point, the timing is critical. Before proceeding, review the following steps.

Setting the Calibration Points

8. Select **Cal** from the NIBP menu.

9. The Monitor displays “Set Pressure to 0 mmHg.”

10. Ensure calibration test equipment is at 0 mmHg.

11. Press **Accept** to continue or **Cancel** to quit this procedure.

12. The Monitor displays “Set Pressure to 200 mmHg.”

13. Apply the pressure (200 mmHg) and HOLD the pressure. Press **Accept** to continue or **Cancel** to quit this procedure.

14. If Accept is chosen, the Monitor will vent the system to atmosphere. Immediately prior to venting, the Monitor stores the set pressure reading into system memory.

The zero reading and the 200 mmHg reading are the only points used for calibration. It is important to ensure that the correct pressures are applied at these two points.

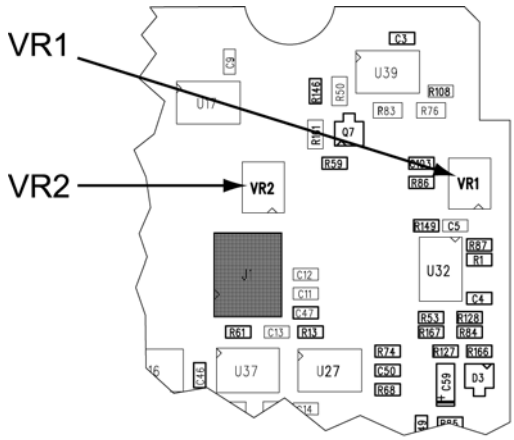
After venting, the Monitor displays “**Calibration is Complete**” or “**Calibration Failed**.”

If the calibration fails, turn off the Monitor, check the calibration equipment and repeat the process. Refer to a GE Medical Systems *Information Technologies* service representative if calibration is still unsuccessful. When the calibration is successful, the following will be displayed on the LCD, “Wait...Storing values,” then after a few seconds the LCD displays, “Turn Monitor off.” The PRO Monitor is now accurately calibrated and can be switched off.

Check the calibration of the unit by repeating the BP-related procedure in 4.6.3.

4.7.2. Overpressure Adjustment

This procedure describes how to set the overpressure thresholds. See Fig 4-2 for adjustment locations.



Component Side of the Main Board

Figure 4-2

Adjusting the overpressure requires opening the PRO Monitor and adjusting the overpressure potentiometers on the Main board.

1. Enable Service Mode.

   a. Power on the Monitor.

   b. Select the **More…** button from the Main menu.

   c. Select the **Service** button.

   d. Enter the Service Mode access code **2 2 1 3**.

   e. Select **NIBP.**

2. Adjust potentiometer VR1 fully counter-clockwise.

3. Manually inflate the system pressure to 315mmHg (the optimal default Adult Overpressure setting.)

4. Once the manometer displays 315 mmHg, adjust VR1 clockwise until the valves release the pressurized system.

5. Perform **Check** again, verifying that the overpressure trips at 315 mmHg ±10 mmHg.

6. Power the Monitor off.

7. Enable Service Mode.

   a. Power on the Monitor.

   b. Select the **More…** button from the Main menu.

   c. Select the **Service** button.

d. Enter the Service Mode access code **2 2 1 3**.

e. Select **NIBP.**

8. Select **Pop off.**

9. The unit will display three zeros in the systolic and diastolic windows.

10. Adjust VR2 (more to the middle of board) fully counter-clockwise.

11. Set the cuff pressure to 157 mmHg ±2 mmHg using your connected NIBP test setup.

12. The air pressure within the system may fluctuate initially. Verify pressure with your external manometer.

13. Adjust VR2 clockwise until the pressure is released and the Monitor displays Systolic: 000 & Diastolic: 000.

14. Verify the overpressure setting by performing the Neonate Overpressure Check 4.6.4.

15.Power the Monitor off.

4.8. ELECTRICAL SYSTEM SAFETY CHECKS

The PRO Monitor is designed to protect the patient from electric shock. To ensure the integrity of these safeguards, use a safety analyzer to perform the following leakage current tests. These tests should be performed on every unit whenever the case is opened before it is returned to clinical service. If any reading exceeds the limit specified, do not return the unit to clinical service.

Ground Leakage

Measure ground leakage current with normal polarity, reverse polarity, and open neutral. Limit is 500 µA.

Temperature System Leakage (PRO 200 & 400)

Set your analyzer to measure leakage current with mains voltage applied to the test probes. Use a temperature plug with the leads shorted and apply the test probe of the analyzer to the leads. The leakage reading should be less than 150 µA.

SpO_2 System Leakage (PRO 300 & 400)

Set your analyzer to measure leakage current with mains voltage applied to the test probes. Use an SpO_2 plug with the leads shorted together and apply the test probe of the analyzer to the leads. The leakage reading should be less than 150 µA.

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5 Schematics & Drawings

For your notes

Table of Contents

5.1 Field Replaceable Parts 5-3

Drawing, Front Case with Temp (3 sheets)..... 5-7/8

Drawing, Rear Case (4 sheets)..... 5-13/14

Schematic, Main Board (9 sheets)..... 5-21/22

Field Replaceable Parts

Kits and Assemblies

Description	Part Number
Assembly, Power Supply, DP 110-410	2012401-001
Includes: PWA, PSU, DINAMAP PRO	
Assembly, PWA Main Board, DP 110	2012402-001
Assembly, PWA Main Board, DP 210	2012403-001
Assembly, PWA Main Board, DP 310	2012564-001
Assembly, PWA Main Board, DP 410	2012565-001
Kit, Rear Case DP 110-410	2012404-001
Includes: Rear Case Molding, DP 210/410 w/temp	
Label, Patent, Side Case	
Label, Battery Replacement	
Connector, Snap-in, Mains Power	
Kit, Front Case w/Temperature DP 210/410	2012405-001
Includes: Front Case Molding	
Label, NELLCOR* or MASIMO** (state at order)	
Label, IVAC*** TURBO★TEMP™	
Kit, Front Case without Temperature DP 110/310	2012406-001
Includes: Front Case Molding DP 110/310 without temp	
Label, NELLCOR* or MASIMO** (specify when ordering)	
Kit, Hardware & Fasteners	2012407-001
Includes: SCREW, M2.5 X 16 CSK POZI, SST, DIN965A	
Screw, Self Tap, Torx, Zinc	
Screw, Pole Clamp, Molded (T1313 M01)	
Screw, Self Tap Posidrive #8X0.5IN	
Screw, Self Tap, Torx, Black	
Washer, 18 ID, 25 OD, 1.5THK, Flat SST	
Washer, 2.5MM X 8MM X 0.5MM Thick	

* NELLCOR is a trademark of Nellcor Puritan Bennett
** Masimo is a trademark of Masimo Corporation
*** IVAC is a trademark of Alaris Medical Systems

Kit, Hardware & Fasteners (continued)	2012407-001
Circlip, .625 Shaft, .485 GROOVE 'E'	
Screw, M2.5 X 16 CSK POZI, SST, DIN965A	
Locknut, M2.5 DIN 985	
Fastener, Wire Saddle, Top Entry	
Grommet, Isodamp, Rubber	
Clip, Retaining	
FT,RND,12.7 DIA X 3.5H Self-Adhesive	
Spacer PCB, 7/16, Nylon Snap-In	
Spacer, Push Mount	
Spacer, LED	
Adhesive INS. Red Glyptol	
Gasket, Battery Support, Adhesive	
FT, RND, 12.7 DIA X 3.5H Self-Adhesive	
Tape, Foam, Single Sided Adhesive, 25X.125THK	
Tape, Foam, Single Sided Adhesive, 2W X 1/16THK	
Kit, Battery DP 110-410	2012408-001
Includes: Battery Door	
Battery Support	
FT, RND, 12.7 DIA x 3.5 H Self-Adhesive	
Label, Battery Replacement	
Kit, Actuator & Light Diffuser, DP 110-410	2012603-001
Includes: Light Diffuser	
Actuator Switch	
Kit, Knob & Pole Clamp	2012409-001
Includes: Knob, Pole Clamp	
Kit, Knob & Pole Clamp (Continued)	2012409-001
Moulding, Pad, Pole Clamp	
Washer, 18 ID, 25 OD, 1.5 thick, FLAT SST	
Pole Clamp	
CIRCLIP, .625 Shaft, .485 Groove ‘E’	
TAPE, Foam, Single-Sided Adhesive	

Screw, Pole Clamp, Molded	
Kit, Printer	2012411-001
Includes: Printer Module Assy	
Kit, Printer Door	2012563-001
Includes: Printer Door	
Label, Printer Paper Loading	
Kit, Pneumatic ASSY w/ Valves	2012412-001
Includes: Pneumatic Assembly Single Valve, 12VDC	
Assembly, VALVE, 12VDC, NC	
Cable ASSY, Dump Valve	
Tubing, Silicone, 1/8 ID x 1/4 OD	
Filter, 40 Micron	
TYWRAP, Nylon, 1.38 BDL DIA. MAX	
Kit, Power Supply Module	2012413-001
Includes: PSU Module, 24V	
Kit, Rotor Knob	2012414-001
Includes: Rotor Knob	
Rotor Shaft	
Spring	
Spacer, push-mount	
Kit, Temperature DP 210/410	2012415-001
Includes: Sensor, Temperature (temp probe sold separately)	
Cable Assembly, TEMP Probe Sensor	
Bracket, Optical, Temperature Switch	
Screw, Self-Tap, TORX, Zinc	
Kit, LCD Module Assembly	2012416-001
Kit, Speaker Assembly	2012417-001
Includes: Speaker Assembly	
Screw, Self-Tap, Torx, Black	
Speaker Clamp Ring	
Assembly, Host Communications Cable	2012418-001
Kit, Printer PWA, DP110-410	2012398-001

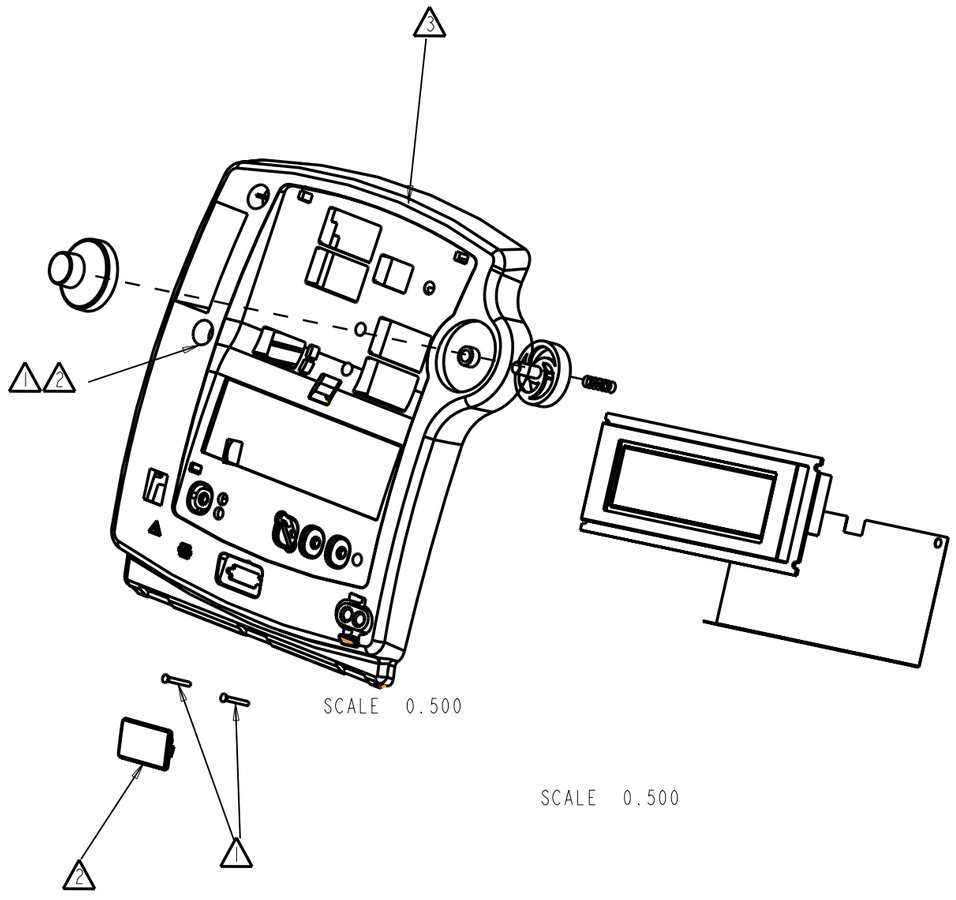
Includes: Printer PWA, DINAMAP PRO	
Kit, NELLCOR SPO2, DP 310/410	2012399-001
Includes: Assembly, Front Case, Nellcor* SPO2 PWA w/spacers	
Label, Nellcor OXIMAX ®	
Assembly, Masimo SPO2 PWA DP310M/410M	2012400-001
Includes: Assembly, Front Case, Masimo** SPO2 PWA w/spacers	
Label, Masimo** SET	

Fascias

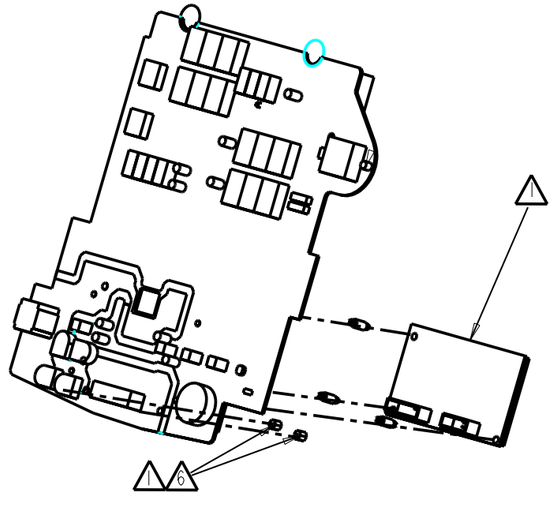
Description	Part Number
English, US, DP410	2012419-001
French, DP410	2012419-001
German, DP410	2012421-001
Spanish, DP 410	2012423-001
English, UK, DP 410	2012424-001
English, Rest of World, DP 410	2012425-001
Help Card, ENGLISH, DP 110-410	2012426-001
English, US, DP 310	2012435-001
French, DP 310	2012436-001
German, DP 310	2012438-001
Spanish, DP 310	2012437-001
English, UK, DP 310	2012439-001
English, Rest of World, DP 310	2012440-001
English, DP 210	2012441-001
French, DP 210	2012442-001
German, DP 210	2012444-001
Spanish, DP 210	2012445-001
English, Rest of World, DP 210	2012446-001
English, US, DP 110	2012447-001
French, DP 110	2012448-001
German, DP 110	2012449-001
Spanish, DP 110	2012450-001
English, Rest of World, DP 110	2012451-001

NOTES:

1. PRO 410 ONLY.
2. PRO 210 ONLY.
3. 2008244-001 PRO 210 & 410.
6. TORQUE SETTING 4 IN LB ± 1/2 IN LB
7. TORQUE SETTING 4 IN LB ± 1/2 IN LB



SCALE 0.500



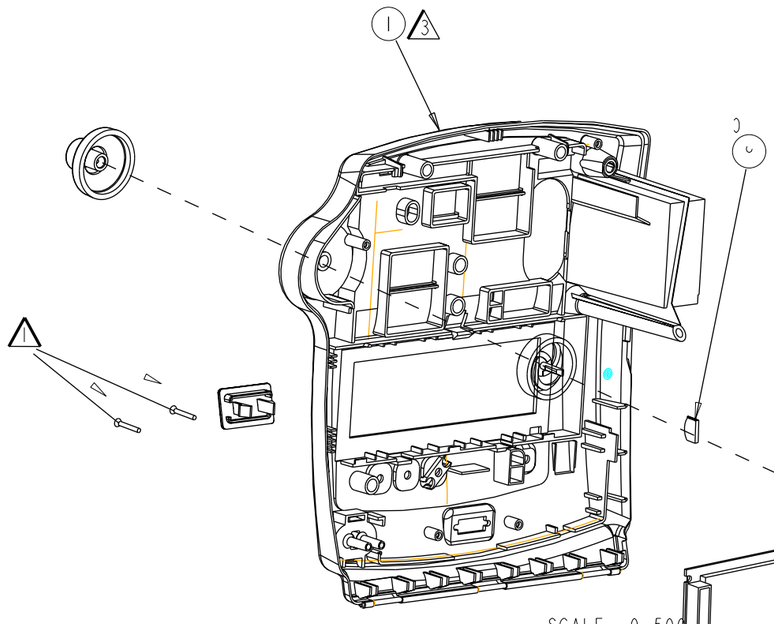
SCALE 0.500

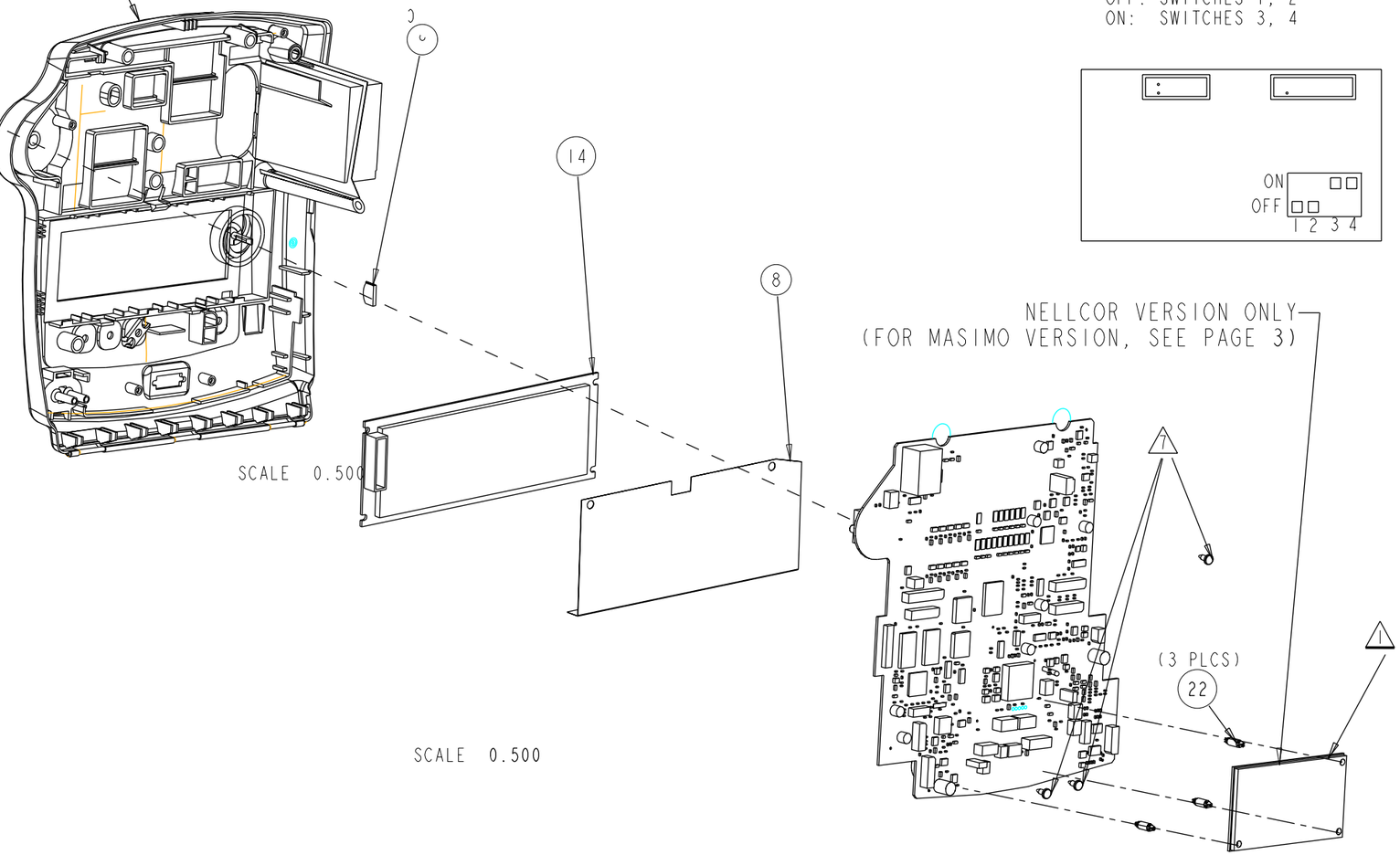
TITLE
FRONT CASE ASSY, W/TEMP

PRO 100-400 Assembly Drawing
Front Case Drawing
Shown with Temp Assembly

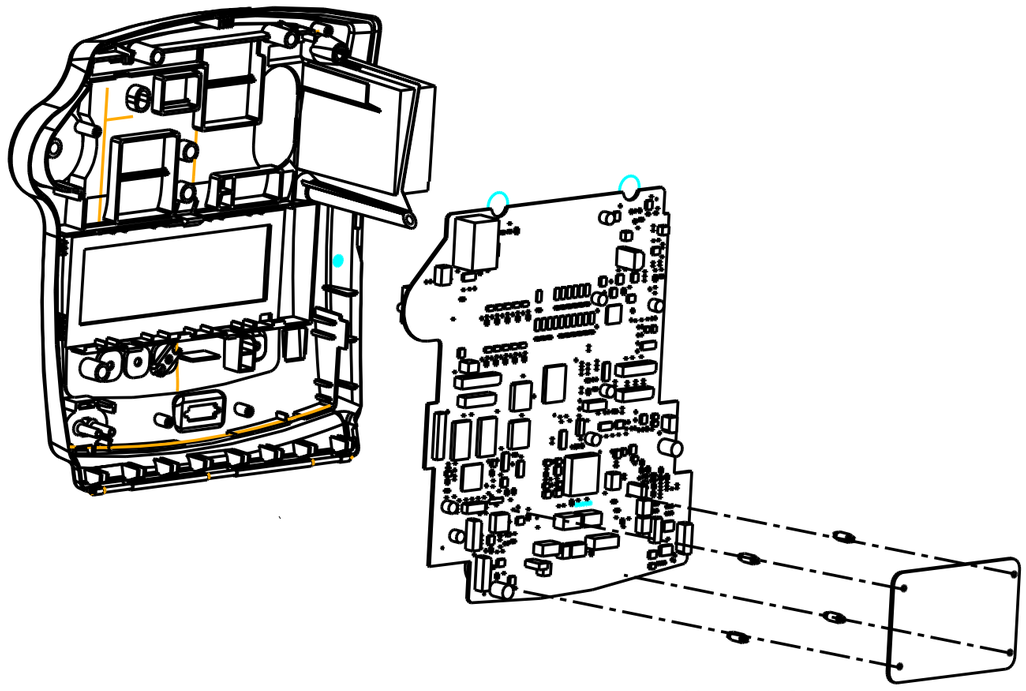
NOTES:

1. BEFORE INSTALLING THE NELLCOR SPO2 PCB (SEQ.13), REMOVE KEY FROM CONNECTOR J2, SET BAUD RATE BY SETTING SW1 AS FOLLOWS:
   OFF: SWITCHES 1, 2
   ON: SWITCHES 3, 4





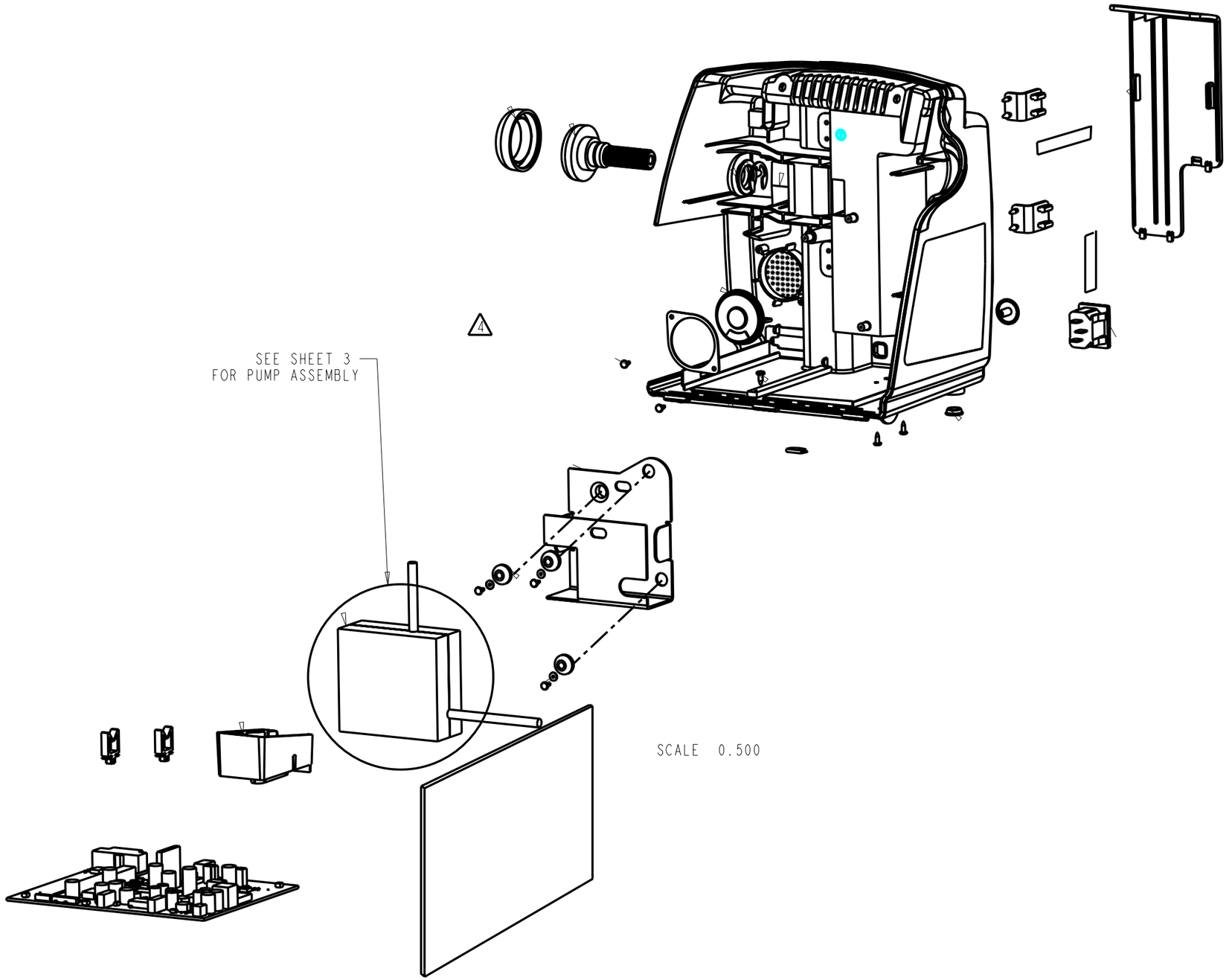
NELLCOR VERSION ONLY
(FOR MASIMO VERSION, SEE PAGE 3)



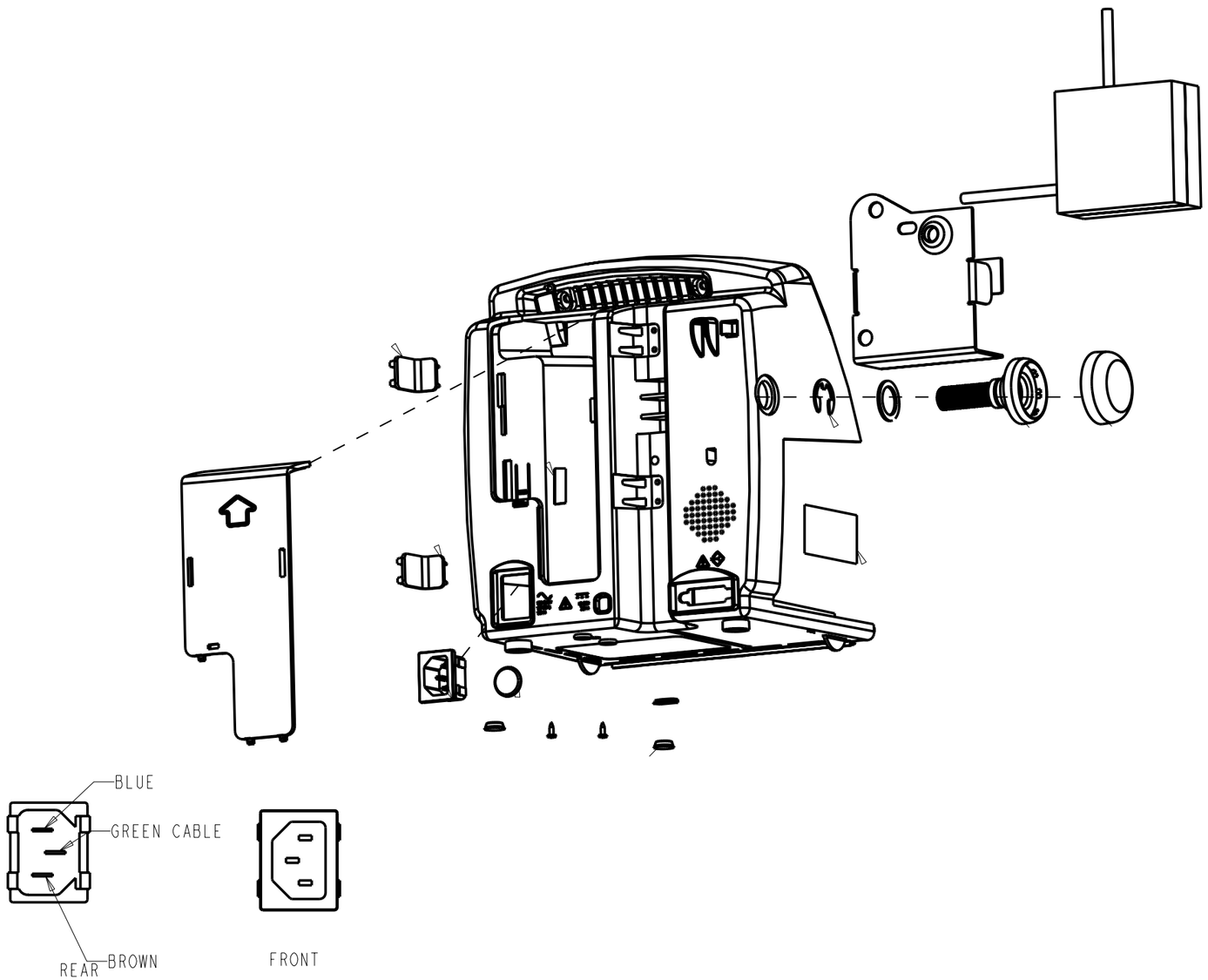
SCALE 0.500

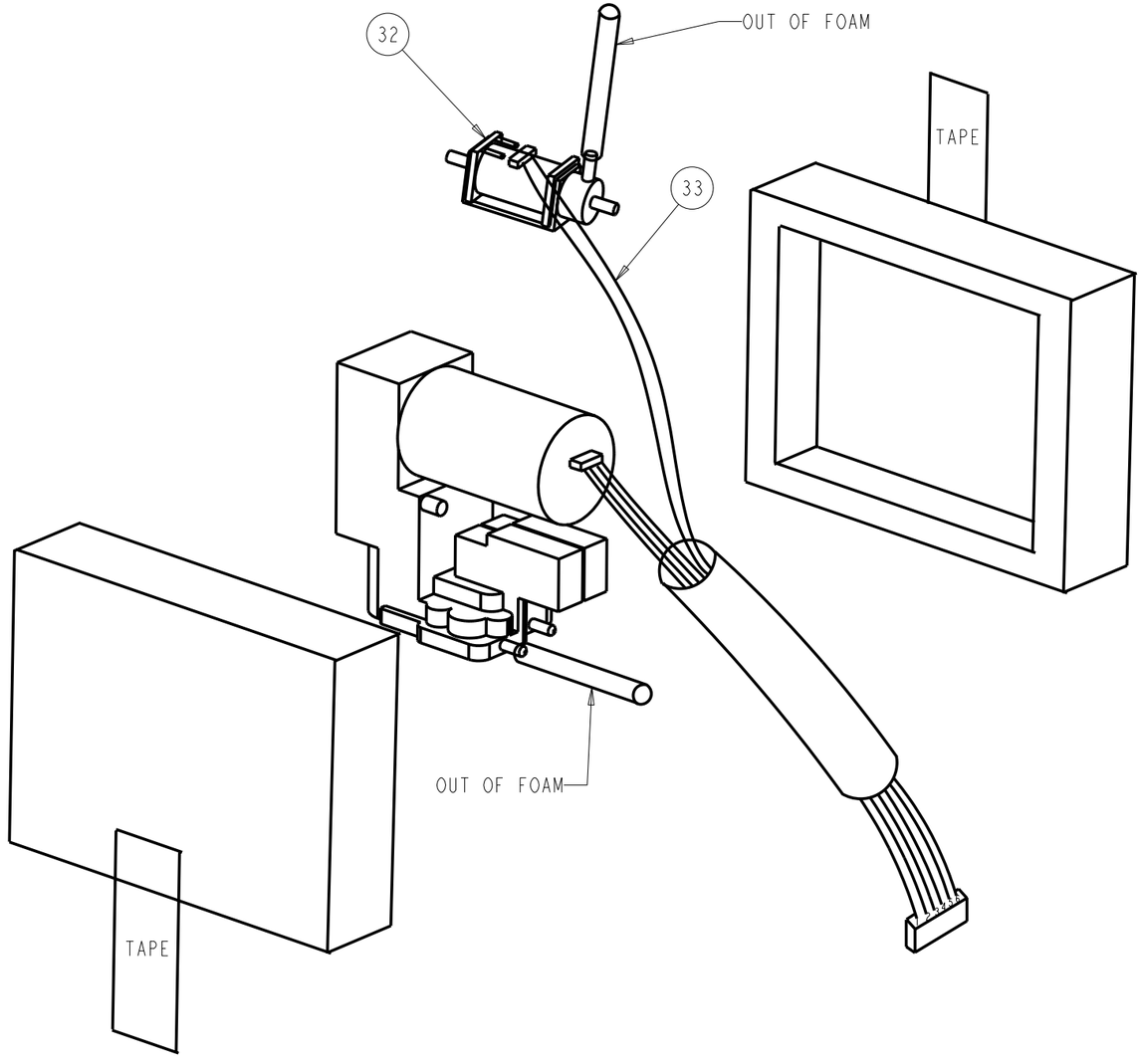
MASIMO VERSION ONLY

PRO 100-400 Assembly Drawing
Front Case Drawing
Shown with Masimo Board

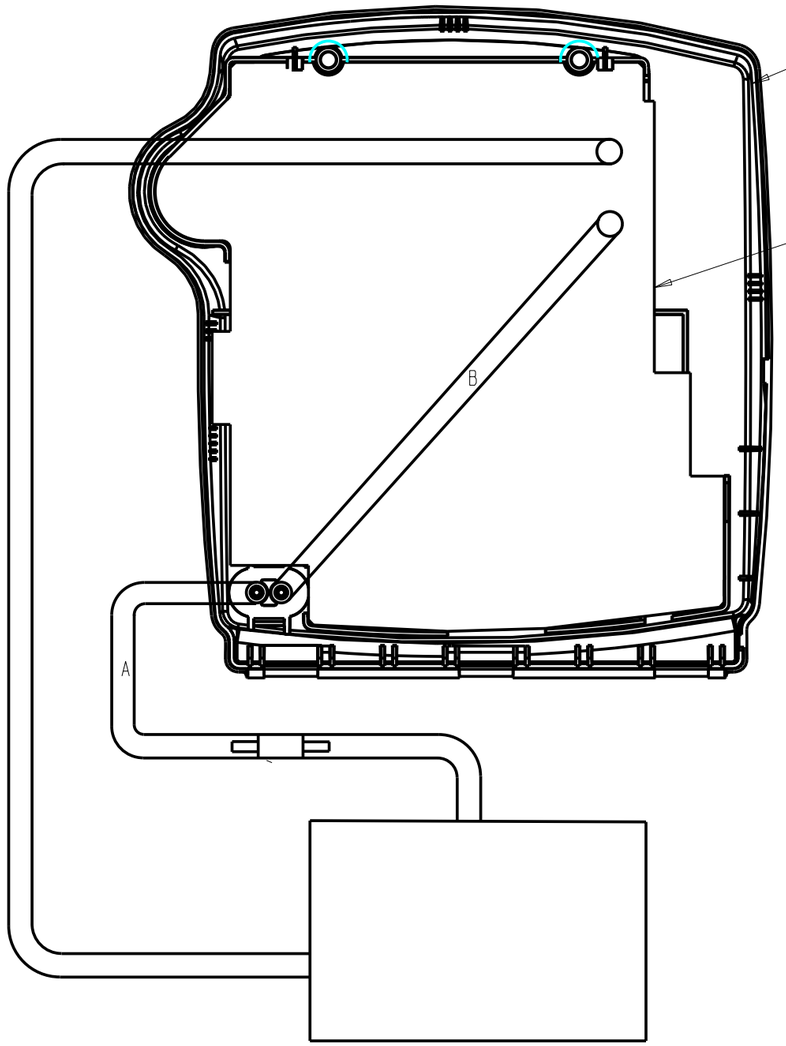


PRO 100-400 Assembly Drawing
Rear Case Drawing


BLUE
GREEN CABLE
BROWN
REAR
FRONT



SCALE 1.000



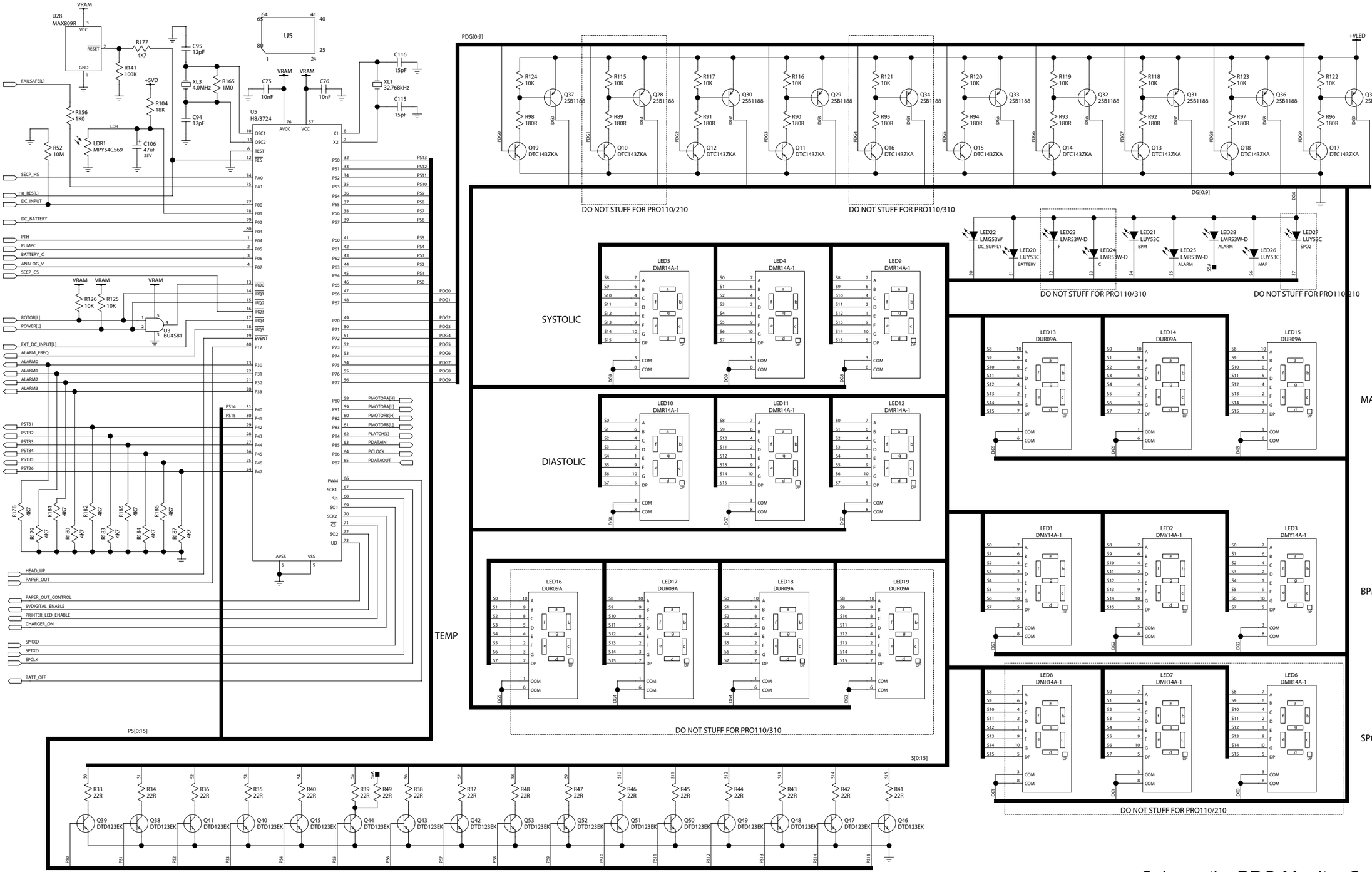
PNEUMATIC CONNECTION DIAGRAM

NOTE:

CUT TUBING (SEQ.20)
TO LENGTHS AS FOLLOWS:

SEGMENT	LENGTH
A	153±5 mm
B	260±5 mm

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 1 of 9



DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

DTD123EK is a digital transistor with a 2K2 base resistor and a 2K2 base pull-down resistor

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 2 of 9

VALVESENSE

ANA+

U34
LM78L12
VIN
VOUT
G1 G2 G3 G4

C92
330nF

C107
47uF
25V

+12VA

C7
100NF
25V

REF-02
TRIM
VIN
U16
VOUT
GND
5.0V

C14
100nF 25V

C10
100nF 25V

PT1
XFPM-050
VCC
VOUT
GND
CAP

R65
0R0

R73
3K3

R66
0R0
NOT INSTALLED

C49
47NF

R85
1K0

C102
680P0

0.5V = 0mmHg
4.0V = 300mmHg
TF = Vs * ((P * 0.00233) + 0.1)

U26
OPA2340

R105
18K

R67
0R0
NOT INSTALLED

C100
470NF

+12VA

REF-02
TRIM
VIN
U17
VOUT
GND
5.0V

C108
47uF
25V

C9
100NF
25V

C11
100nF 25V

PT2
XFPM-050
VCC
VOUT
GND
CAP

R74
3K3

R68
0R0
NOT INSTALLED

C50
47NF

R86
1K0

C103
680P0

U27
OPA2340

C46
1nF

PUMPC

SWBUS[0:7]

LWE[L]
CS3[L]
CS2[L]
DCLK_X2

C13
100nF 25V

C12
100nF 25V

C109
47uF
25V

R2
10R

C51
10uF
16V

C6
100nF 25V

+12VA

R147
200K

2.396V

ANALOG_V

R78
49K9

ANALOG AND DIGITAL GROUNDS
MUST BE MANUALLY CONNECTED IN LAYOUT

MAX4617
V+
S0 S1 S2 S3 S4 S5 S6 S7
D
A0 A1 A2
EN
V-
U37

U27
OPA2340

R13
510R

C47
1nF

U35
ADS8320
VCC
VREF
DCLK
DOUT
CS
GND

R11
510R

R10
510R

R12
510R

+5VD

C16
100nF 25V

C15
100nF 25V

VCC1 VCC2

U19
CY37064
V2_CHIP

SWBUS7
SWBUS6
SWBUS5
SWBUS4
SWBUS3
SWBUS2
SWBUS1
SWBUS0

PROBE_SW
ALARM_SILENCE_SW
START_STOP_SW
STAT_SW
POWER_SW
CHA_SW
CHB_SW
ROTOR_SW
SERIAL_DIN
RESETL
ADDR7
ADDR6
ADDR5
ADDR2
ADDR1
ADDR3
WEL
CS3L
CS2L
CLK_IN

DCLK_OUT
CS_ADC
ADC_BUSY
DATA
LCD_CS
PNEU_CS
MUXADDR2
MUXADDR1
MUXADDR0

GND1 GND2 GND3 GND4

DCLK
CS_ADC[L]
ADC_BUSY[L]
D7
D6
D5
D4
D3
D2
D1
D0
LCD_CS
D[0:7]

U19

MUXADDR2
MUXADDR1
MUXADDR0

A[1:19]

U30
HC259
PNEU_CS[L]
12V_ON
DEFLATE
DUMP[L]
PUMP_ON
D_TO_TEMP[L]
LCD_BACKLIGHT_1
ADULT[L]
RESET[L]
UNFIL_OVP[L]
FLT_OVP[L]

+5VD
C8
100nF 25V

C3
100nF 25V

+12VA

R64
10K
0.1%

R146
11K
1%

R50
90K9
0.1%

U39
TLC2272

R108
887R
0.1%

R76
2K74
0.1%

R83
21K
0.1%

VR1
10K
CW
ADULT OVP

R161
1.5K
1%

VR2
10K
CW
NEO OVP

Q7
2N7002

R59
47K

+5VD

C4
100nF 25V

+12VA

R1
10R

U32
LM393

R149
30K
1%

C5
100NF
25V

+5VD

R87
1K0

D3
BAS16

R166
330K

R127
10K

C59
1uF
16V

R53
10M

+5VD

R128
10K

U32
LM393

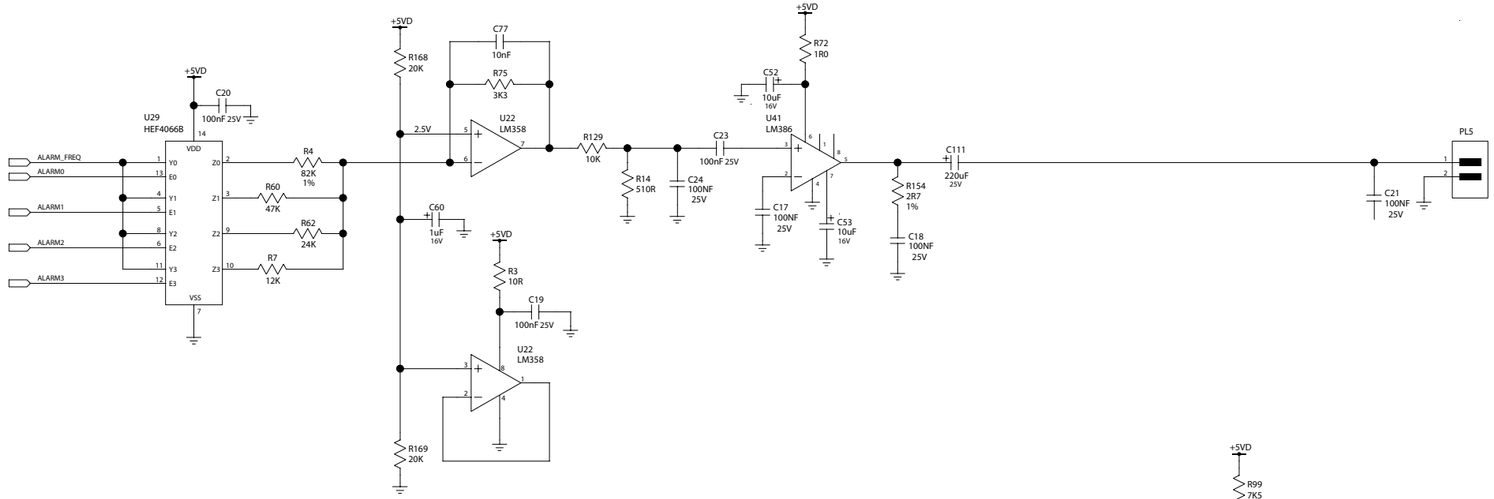
+5VD

R84
68K
1%

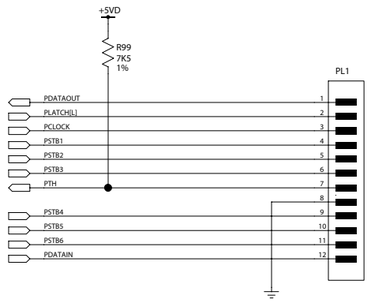
1.14V

R167
20K

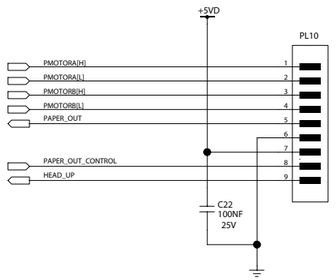
Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 3 of 9



SPEAKER CONNECTOR

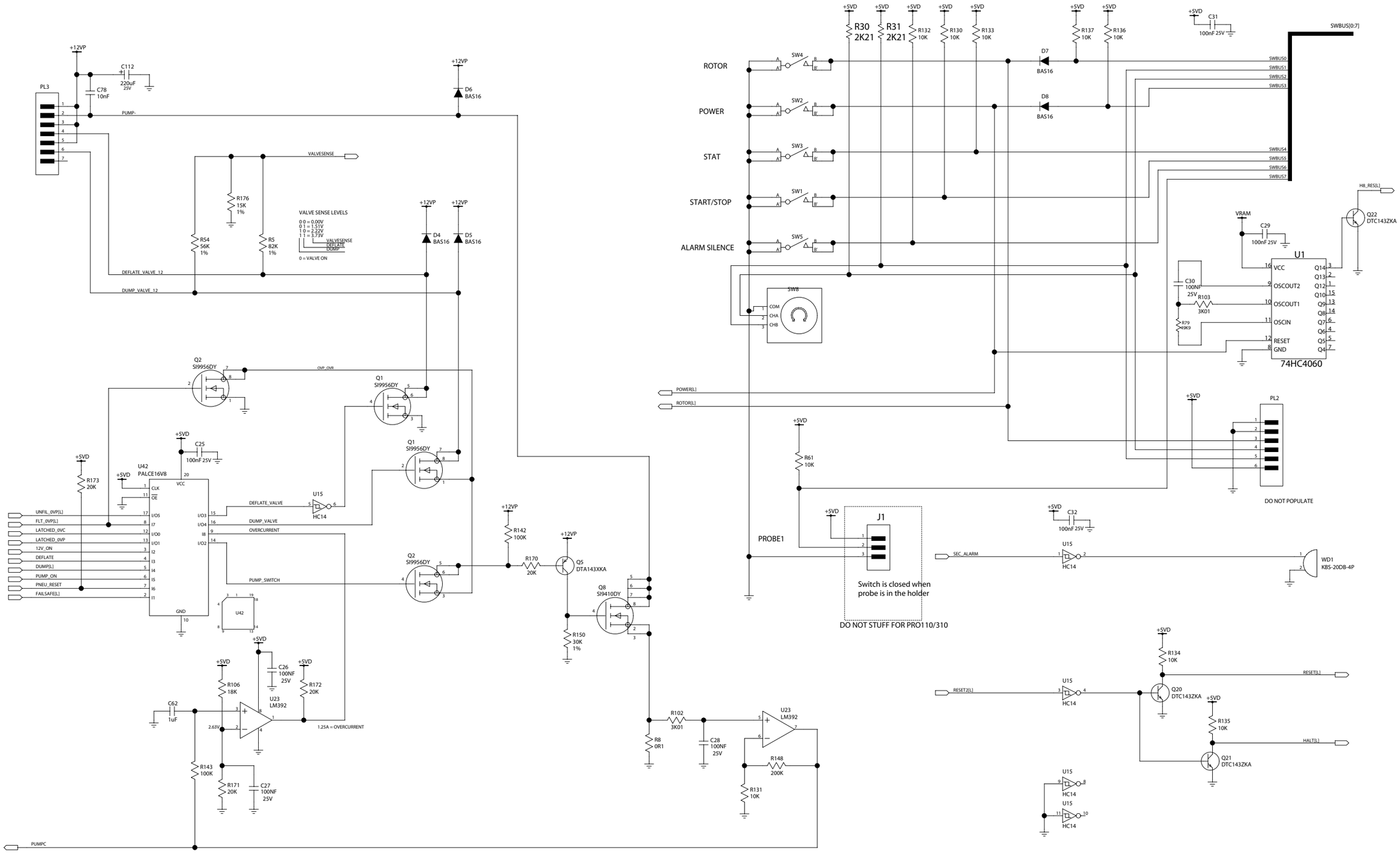


PRINT HEAD CONNECTOR



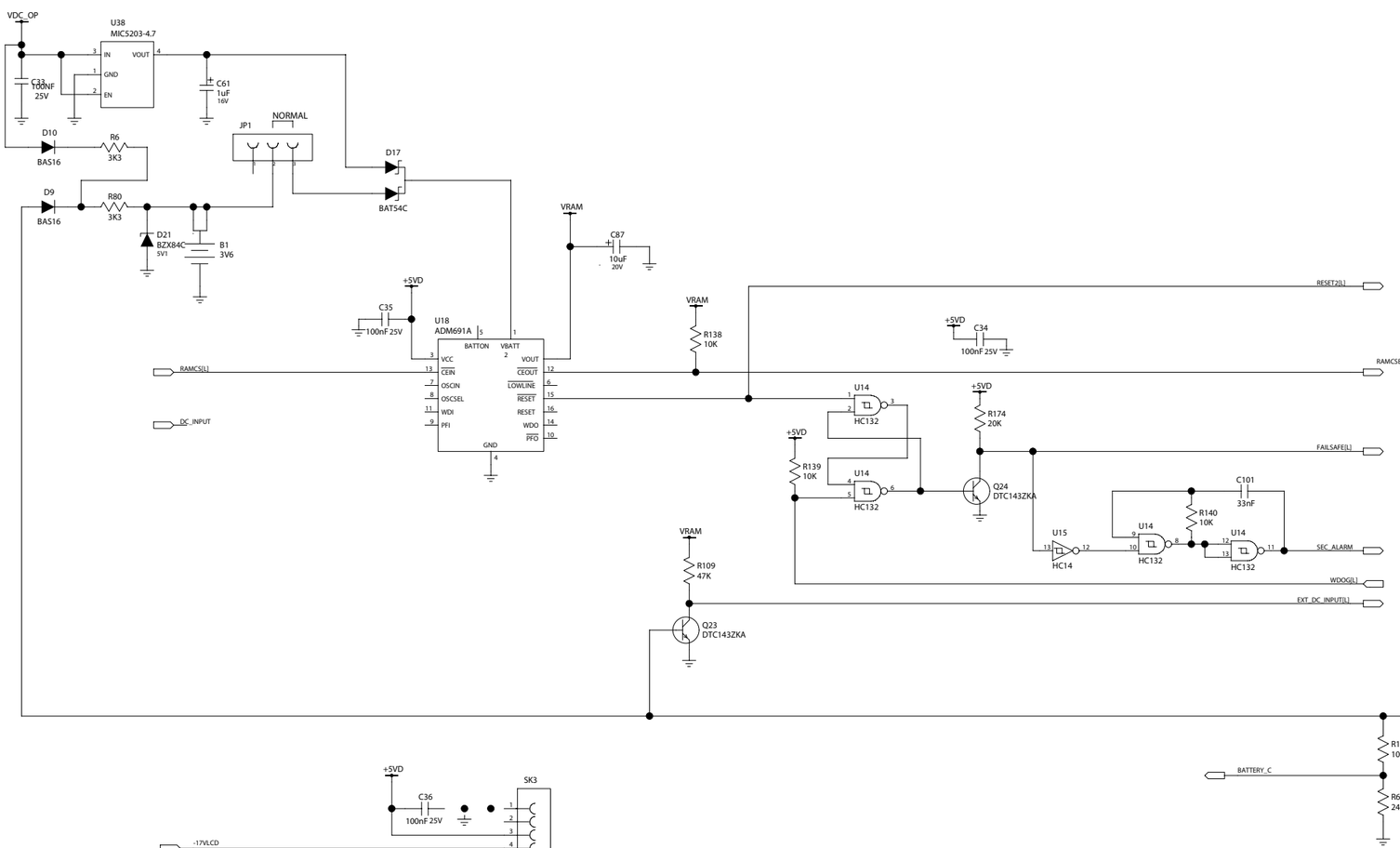
PRINT MOTOR / SENSOR PCB CONNECTOR

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 4 of 9



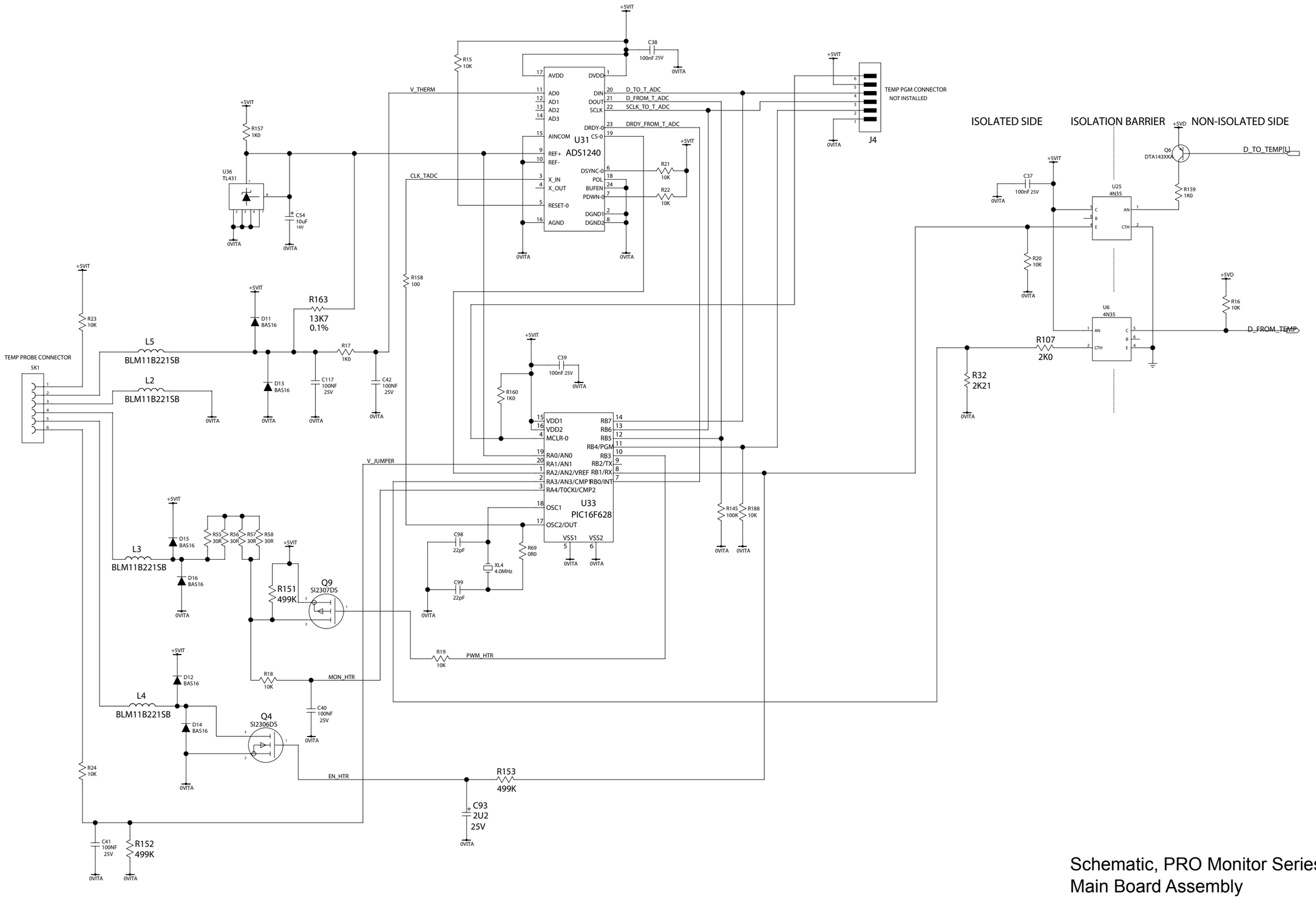
DTA143XKA is a digital transistor with a 4K7 base resistor and a 10K base pull-down resistor
DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 5 of 9



DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

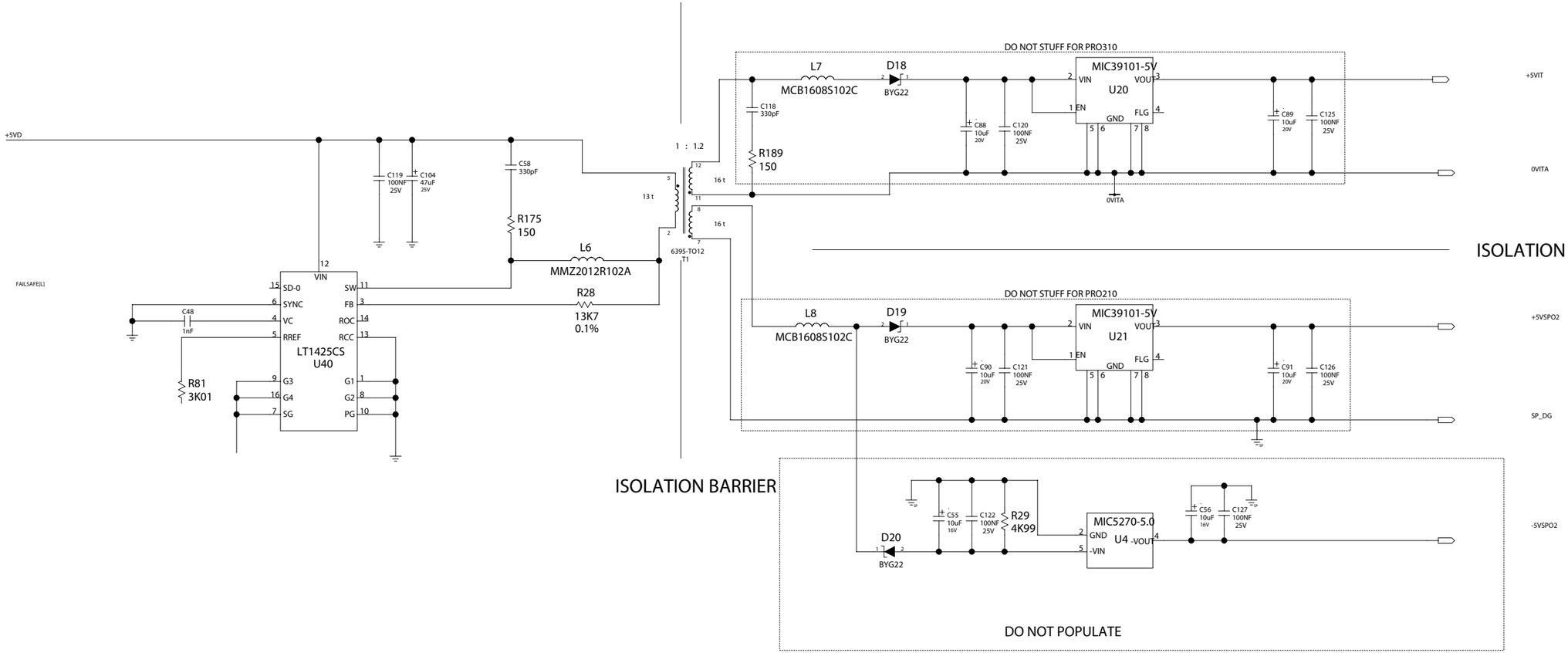
Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 6 of 9



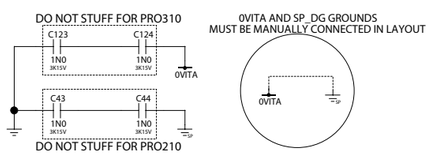
NOTE: COMPONENTS ON THIS PAGE NOT POPULATED FOR PRO110/310 EXCEPT R16 (D_FROM_TEMP)

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 7 of 9

ISOLATED POWER SUPPLY



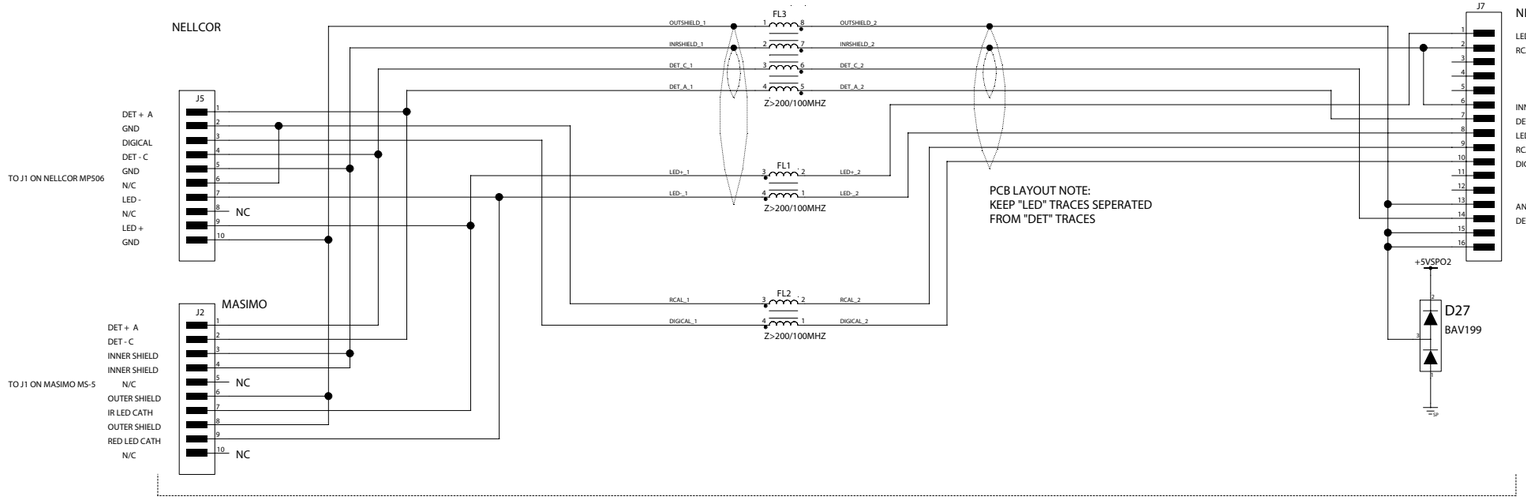
ISOLATION BARRIER



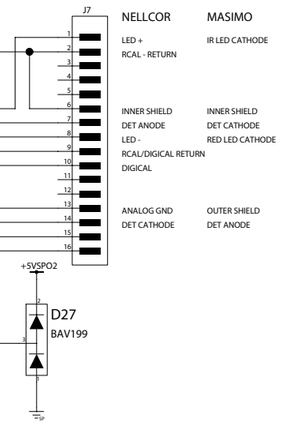
NOTE: COMPONENTS ON THIS PAGE NOT POPULATED FOR PRO100

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 8 of 9

SPO2 MODULE CONNECTOR

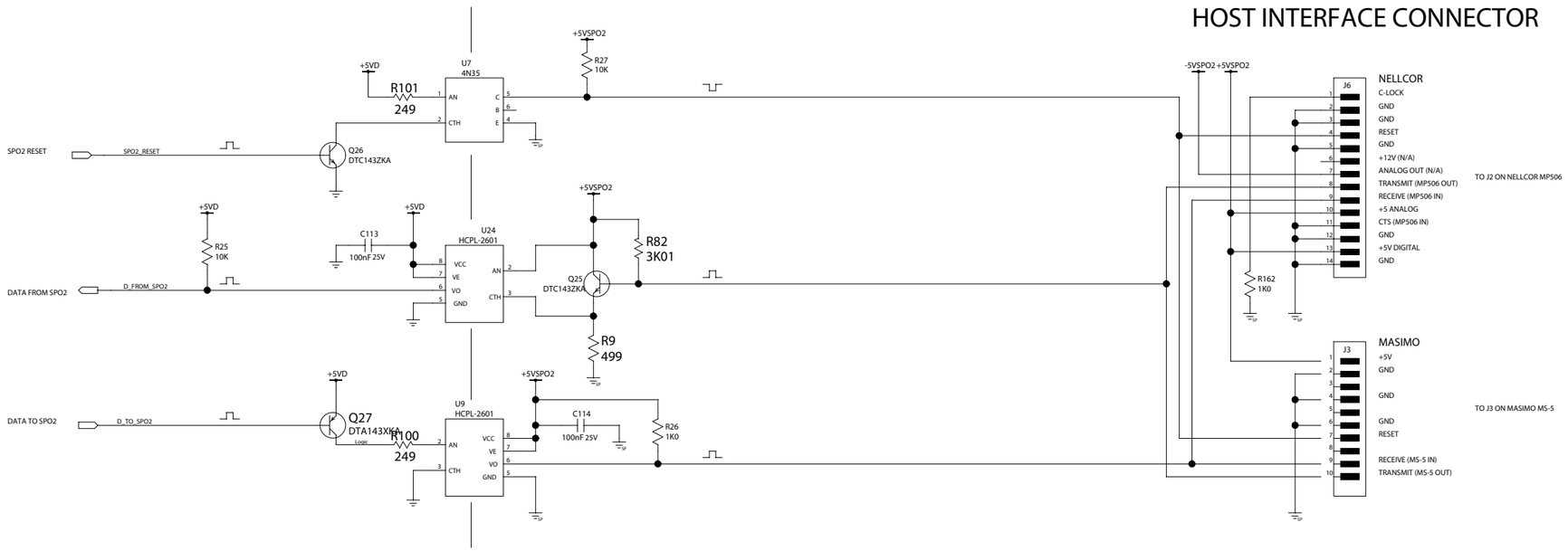


SPO2 PATIENT CONNECTOR



ISOLATED SIDE

HOST INTERFACE CONNECTOR



NON-ISOLATED SIDE ISOLATION BARRIER ISOLATED SIDE

ALLOW 4.5MM CLEARANCE BETWEEN ALL NON-ISOLATED AND ISOLATED SIGNALS

NOTE: COMPONENTS ON THIS PAGE NOT POPULATED FOR PRO110/210 EXCEPT R25 (D_FROM_SPO2)

Schematic, PRO Monitor Series 1-400
Main Board Assembly
P/N: 2008238-001 C
Sheet 9 of 9

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